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THE EFFECTS OF TRADE UNIONISM UPON SKILLED MECHANICS.

By Hiram S. Maxim.

BY skill in mechanics we mean not only skill in producing an article, but also the skill which enables one to produce it quickly. There are many amateur mechanics, especially among college professors, who are able to turn out exceedingly good work, but the rapidity with which they are able to do so would not be sufficiently great to entitle them to be called skilled mechanics. Skill, therefore, relates to something more than sufficient ability to do the work. Not only should the skilled mechanic be able to do the work and to do it quickly, but he should also be able to execute any work that relates to his profession. For instance, if he is an engine-builder, he should be able not only to fit a crank-pin and bore out a cylinder, but also to do any fitting, turning, or machining connected with a steam engine. Again, a skilled gun-maker must be able to make a complete gun, doing not only the machine work, but also the fitting. A man able to make only one of the minor parts, to work a single machine or a single kind of a machine, or to fit a certain part, is not to be considered a skilled gun-maker. He might be a skilful spring-maker, a skilful filer, or a skilful turner, but not a skilful gun-maker.

At the present time the trade unions seek to specialize work and to put every obstacle in the way of learning more than one thing. I remember employing a very skilful Swiss mechanic. He was not only an exceedingly good fitter, but one of the best men on a planing machine I had ever seen. On one occasion, while working as a leading hand in the fitting shop, it became necessary for him to do certain work on a planing machine. As there was no one on hand to do the

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work, he did it himself, and, in consequence, was warned by the trade union that this would not be allowed. He replied that he was a master of his profession, that he prided himself on being able to work every sort of machine relating to his profession, and that, if the trade union would not allow him to work at his own profession in his own way, or wished to curtail or interfere with his working the tools that he had learned to work as an apprentice, he wished to withdraw from the union—which he did.

During the last twenty years the milling machine has come very much to the front, and is employed to-day on a great variety of work. An unskilled laborer is able to adjust the machine, place a piece of steel in it, and rough it out approximately to the shape and size of the finished article, but it requires both time and skill for the fitter to reduce it to the exact dimensions required. A skilful hand on a milling machine is able, however, to reduce the work to the exact dimensions required, so that little or no filing is necessary, and to repeat the operation with certainty and at a rapid rate. This is the difference between skilled and unskilled labor.

If the United States are to maintain their position as manufacturers of articles of iron and steel, the work must be produced both quickly and cheaply, and, if milling machines are employed, the operator must seek to reduce the work to the exact dimensions required, so as to save the expense of filing and adjusting. But the trade unions look upon this from a different standpoint. In a factory completely under the influence of the union, it was found that the milling was exceedingly bad,—that everything was left large, clumsy, and rough. In order to prove what could be done with milling machines, a certain amount of work was sent to the tool-maker, who did not belong to the union, and he milled the work down to the exact size required, practically dispensing with the work of the fitters. When this work was shown to the trade-union hands, they remarked that it would never do ; it left nothing for the fitters, and what would they do if the millers and machine men did not leave any steel to file off ?

When we first commenced to make Maxim guns on a large scale, I had dies made for the drop forgings which left only about $\frac{1}{32}$ of an inch to be milled off. When, however, the place was put under the charge of a trade-union man, he enlarged all the dies, which greatly increased the weight and size of the forgings, and for no other purpose than to give the men more work to do in milling off the superfluous steel. In some cases the drop forgings were made so very heavy that a portion of the steel was cut off on a shaping machine before being milled at all. When the union man was discharged, and a non-union man put in his place, the dies were all reduced again to

their original dimensions; and it may be interesting to note that, when these same forgings were sent to a great German manufacturer, he complained that they were too heavy, although there was barely a thirty-second of an inch to be removed by the milling machines.

In order to show the difference between good milling and bad milling, trade-union work and piece-work, I will refer to one little part of the Maxim gun. When this part was very roughly milled and left a great deal too large by the union men, it required more than a day for the fitter to file it into shape. At the present time, however, the milling is so accurate that the fitter is able to do fifteen pieces in one day, or twenty times as much as he did formerly.

When Smith & Wesson, the celebrated pistol-makers of Springfield, Mass., wished to show the skill of their workmen, they exhibited a revolver in perfect working-order which came direct from the machines, not one part of it having been touched with a file; and, when Ludwig Loewe, of Berlin, secured a large order for similar pistols for the Russian army, he also exhibited a complete pistol which no fitter had ever touched with a file. It is said that the remarkable cheapness of the Winchester rifle is due to the accuracy of the machine-work, little or no expensive filing or fitting being required.

But there is another side to the milling question. When we began to make guns, we employed members of the Amalgamated Society of Engineers on all our tools,—one man to each tool,—and it was surprising how little work we got out of them. They not only ran the machines at a very low speed, but took a very small cut. I had noticed in France that one operative often ran from four to six of these milling machines. On one occasion, finding one of our leading hands, a strong union man, in Paris, I took him into a French shop to show him the rapidity with which the work was turned out. I pointed out to him that the machines were running with double the speed, and that they were taking at least double the cut that they did at our place, while one girl was working six machines, and, instead of getting from eighteen to twenty-four cents an hour, these girls got only about ten cents an hour. On his return to England, he made a most interesting and instructive speech at a trade-union meeting held at Crayford. He pointed out that, whereas the Crayford Works at that time were employing more than three hundred hands, if the men should do as much work as these French women did, only about sixty would be employed. He said he had figured it carefully out, and he asked what in the name of heaven would become of the other two hundred and forty hands. "Shall we allow them to starve?" said he.

On another occasion, finding the chairman of our company in Paris, I took him to the same works, expecting to find the same state

of affairs. On entering the room, however, I found that the girls were no longer there. They had been moved into another and a larger room, where each girl, instead of working six machines, was actually working thirteen milling machines, which were running at the time on sheep-shearing appliances to be used in the British colonies. At the present moment we employ boys very largely on milling machines, and each boy, as a rule, takes charge of four machines, but of course it requires great skill on the part of the tool-makers to keep the tools in order, and to adjust the machines so as to turn out accurate work. At the French factory referred to, I found a large room completely filled with automatic machinery, with only two attendants.

The skilled mechanic of the greatest value at the present time is he who is able to produce machines and tools to a large extent automatic, which can be taken charge of by young and unskilled persons. There is no question that the tendency on the continent and in the United States is to produce machines which practically run themselves. A bar of steel is placed in a machine, the machine is started, and the bar is cut up into screws or other objects, the machine performing all the necessary functions automatically. As these machines require very little attention, it is obvious that one hand can take charge of a considerable number. But this again is discouraged in England. If the machine is large, elaborate, and complicated, the unionists insist that it should be taken charge of by what they are pleased to term a skilled hand. I remember that on one occasion several delegates were sent to us by the Amalgamated Society of Engineers with a complaint that we were allowing an unskilled man to work a Brown & Sharpe milling machine. The chief spokesman was a very young man. He said that this machine was of a very high order, and ought by rights to be worked by a man skilled in the art, and not by a mere laborer. We informed him that the man who was operating the machine was indeed a skilled man, that he was able to do the best work done in the place, and that he had worked a milling machine for thirty years, beginning several years before the spokesman himself was born. We asked him if he could do better or quicker work than the man complained of. He said that he did not think he could do it as well. He admitted that the man was able to do the work, but said that technically he was not a skilled mechanic, because he had not served as an apprentice before he was of a certain age. Consequently, no matter what he might do afterwards, or how skilful he might really make himself, he must remain forever technically an unskilled workman, work for lower pay, and be debarred from doing the fine work that he was so well qualified to do. I found that this same feeling existed all over England. We constantly heard of trade

unions interfering and striking because a really skilful man was allowed to work an intricate machine.

In the United States trade unionism is confined for the most part to unskilled laborers. I find that very few of the first-class mechanics employed in New England, or even in New York, belong to any union. Each man relies upon himself, and each, instead of attempting to turn out as little work as possible, is really attempting to get ahead of his fellow-workmen; in other words, each is attempting to beat all the others, either in rapidity or excellence of workmanship, and, as a rule, there is no standard of price, each man being paid in proportion to what he is able to do. The man is considered the most skilful who is able to do the best work in the shortest time. In a large shop like that of Pratt & Whitney, where, say, a thousand hands are employed, it is no exaggeration to say that at least eight hundred of these hands are expecting to rise to the top, each by his own efforts. It is this struggle to excel in work and rapidity of production that produces the incomparable mechanics of New England.

I remember the instructions that I received when I was a boy and working on an engine lathe. My instructor was a Scotch Canadian who had settled in the United States, and he was the most rapid workman that it has ever been my fortune to meet. He said: "If you wish to turn out work quickly on a lathe, and get ahead of the other fellows, give your lathe all the work it will do, and keep it in the cut all the time. Never take a tool out of your lathe unless you have got another one ready ground to put in, and change your tools as quickly as possible. Be sure and run on your belt, and start your lathe as soon as the engine has made its first turn, and never stop your lathe until the engine stops. It matters little what you do yourself, so long as your lathe is at work."

In England, however, at the present time, the lathe-hand dawdles in a minute or two after the engine has started, and, by the time it pleases him to start the lathe, the engine has often been running five to ten minutes, while no man ever thinks of such a thing as grinding a tool and getting it ready while the lathe is still making a cut.

If we consider rapidity as well as excellence of workmanship, I think anyone must admit that the trade unions have a very detrimental effect upon the development of skilled mechanics. There can be no question but what the value of a mechanic to the country in which he lives depends altogether upon the skill which enables him to do work quickly. If we are able in England to do better work than is executed in the United States or Germany, we can hold our own and keep the trade, if we sell at the same price; but, if our competitors produce an equally good article and put it in the market at a lower

price, they will, in time, capture the trade and leave us out in the cold. It is no use to shut our eyes to the fact that good work is being done in other countries, notwithstanding the fact that the trade unions would have us believe that no mechanical work of any value can be executed except in England.

Some years ago, when we had a strike at our Erith Works, one of our foremen made a speech in which he pointed out the fallacy of every man working at his own particular gait. "For," said he, "there are many of us who can easily do three to four times as much work in a day as our weaker and less skilful companions. In a large shop like this, where thousands of men are employed, there will always be found a considerable number of men who are not strong and healthy and who have little skill. These men are able to do only a limited amount of work. If the strong and healthy men do more work than our weaker comrades are able to do, what is to become of our weaker comrades?" He pointed out that, in order to keep these men employed, and to give them a fair chance, it was necessary for the stronger and more skilful mechanics to reduce the output to the rate at which these less-favored brethren were able to do it. Evidently a society whose leading lights make speeches of such a character cannot be considered favorable to the development of that kind of skill which enables a mechanic to turn out work rapidly.

Some years ago, finding that the brass-working lathes usually employed in England were of a very poor quality, I purchased some high-class lathes in Boston. Though these lathes cost five times as much as the English lathes, the output remained the same. On several occasions I attempted to show the workmen how to use these lathes,—how to take advantage of the many appliances and adjustments provided for the purpose of turning out accurate work quickly, —but all in vain. One day, however, I went to the forge myself, forged out a set of tools, tempered and ground them, and did some of the work myself. This I regarded as a practical demonstration. I proved to the men that, by having proper tools, and taking advantage of the various stops and appliances for duplicating work, I could turn out from six to ten times as much as they had been doing. The man whose lathe I had used thanked me very much, and the next day I saw he was doing quite as well as I had been doing myself. However, at the end of a month he had completely relapsed into his old ways. All the tools which I had made had disappeared, and the output was identically what it would have been if it had been done on a cheap English lathe. Other men were tried, but always with the same result. Absolutely no advantage was to be derived from the use of the new lathe. At first it appeared to me that it was negligence or stupid-

ity, but afterwards I learned that the trade union had remonstrated with the workman, and cautioned him against doing so much work. "If Maxim wants more work done, why does he not get more men?"

The unionist, as a rule, is not a thinking man. If he were a thinking man, he would not belong to the union. It appears to his clouded intellect that there is a certain amount of work that has to be done, anyway, and that this quantity is fixed. Consequently, he looks upon work as something that ought to be nursed and made to go as far as possible. It appears to him that, the more he gets per hour and the greater number of hours he can be employed upon a job, the greater the yield to his society. It never occurs to him for a moment that, if this were carried to extremes in either direction, the whole thing would be changed. For instance, if the cost of mechanical work should be increased twenty-five per cent. in England, the greater part of it would be driven into foreign countries, whereas, if it could be produced in England for twenty-five per cent. less than in other countries, there would be more than enough work for everyone that could be employed in England. If an Englishman were forced to use the same implements and to spin and weave in the manner in vogue in India, he would be unable to produce cotton cloths in England which could be taken to India and sold at a profit, but, with the improved appliances in England, cottons have been made so cheaply as to make native competition impossible in India, except when the same appliances were employed, and for a long time it might be said that England had a monopoly of cotton goods over the greater part of Asia. In this case success did not depend upon the ability to produce a fairly good article, but altogether upon the ability to produce it rapidly and cheaply. Yet it will be remembered that the very instruments employed to enable the English to compete on so favorable terms were fought, tooth and nail, by the weavers themselves.

Anything which serves to curtail or limit the output is not only detrimental to the country, but to the workman himself, and any society which encourages its members to nurse his job and make it last—that is, to dawdle, and to do it very slowly—not only does much to discourage the development of skilful mechanics, but also does great damage to the trade of his country.

It appears to me that trade unions oppose, and always have opposed, the use of machinery which enables work to be turned out quickly and cheaply, and I believe there has never been a machine, apparatus, or system introduced into England which has helped to give her the position which she now occupies as a great manufacturing nation, which has not been opposed tooth and nail by the ignorant and unthinking who make up the rank and file of the English trade unions.

FUTURE SUPREMACY IN THE IRON MARKETS OF THE WORLD.

THE UNITED STATES VS. EUROPE AS A MANUFACTURING COMPETITOR.

By J. Stephen Jeans.

THE insular prejudices and the complacent self-sufficiency of the average Briton have long hindered him from understanding or admitting the possibility of other nations ultimately occupying fields of industrial activity that he has for generations been accustomed to look upon as entirely his own. The earlier prophets of the impending danger were treated with even more than the ordinary amount of intolerance proverbially accorded in their own country to those who do not prophesy smooth things. Here and there, however, a voice was heard crying in the wilderness. Cobden, more than fifty years ago, pointed out that "it was to the industry, the economy, and the peaceful policy of America, and not to the growth of Russia, that politicians and statesmen of whatever creed ought to direct their anxious attention, for it was by these, and not by the efforts of barbarian force, that the power and greatness of England were in danger of being superseded." Lytton, in his "Coming Race," speaks of that American, and notably industrial, progress "in which Europe enviously seeks her model, and tremblingly foresees her doom." For years past the "lights in the window" have shown that British industrial prowess was not so safe as it was supposed to be, and that the threat of American competition on a colossal scale was not a mere phantom. But that possibility has never been brought so near to our inner consciousness as it is at the present time, when almost every branch of our mechanical industry is threatened with competition of the fiercest kind by the United States.

Great Britain is now importingAmerican pig iron, American steel rails, American wire, American agricultural machinery, American machine-tools, and many other American products. The aggregate value of these importations must be very considerable. I know of one case where a single firm imported last year, in six months only, American machinery, including machine-tools, to the value of nearly £150,000. That this competition has come to stay appears to be generally admitted. The conditions and prospects of American competition appear, indeed, for the moment, to overshadow every other industrial problem, except that of labor, with which it has a closer affinity than is usually supposed, and to call for the most serious consideration.

It is one more example of how history repeats itself that England should to-day be witnessing so remarkable a development of competition with the United States. It will probably be among the things not generally remembered that American competition in the iron trade was a *bête noir* of Englishmen in the last, and in the early part of the present, centuries, although under very different conditions. In the first half of the eighteenth century the iron trade of Great Britain was in danger of extinction, because of the exhaustion of supplies of timber, upon which the trade then depended for fuel. Indeed, it began to be feared that, owing to the large amount of timber required for the manufacture of charcoal to feed the furnaces of that day, "there would not be oak enough left to supply the royal navy and mercantile shipping."

It was under these circumstances that efforts began to be made to stimulate the importation of iron from the then British colonies of North America. The then house of commons, however, looked only to the interest of the mother country, and treated the colonists in this, as in other matters, with an absence of consideration that has had its aftermath in many episodes of more recent times. They were to be permitted to produce pig and bar iron, because it suited the needs and extremities of the mother country that they should do so, but they were "not to manufacture iron wares of any kind whatsoever, under certain penalties." *

Not more discreet was the action of the house of lords, which added a clause to the effect that "no forge going by water, or other work whatsoever, should be erected in any of the plantations, for making tows, pigs, or cast iron into bar or rod iron." This provision does not appear to have come into effect at the time, owing to the conflicting interests involved—the merchants promoting, and the iron manufacturers opposing, the free import of American iron into Great Britain. But an act was passed in 1750, which provided that no works or mills should be permitted in the American colonies for the manufacture of iron or steel. The colonies, in fact, were absolutely interdicted from taking such action as would enable them in any way to compete with the mother country.

At the present time, as we have indicated, there is no individual influence that is causing more apprehension as to the future of the iron trade of Great Britain than the growth of American competition. As yet, the danger does not appear to be serious,—not at any rate in its actual extent. Probably a large majority of those who have not had the opportunity of studying the conditions have hardly realized that there is any danger. In truth, it is difficult to suppose that there can

* Provision of bill introduced into parliament in 1719.

be much menace to Great Britain's industrial status on the part of a country which is not only more than three thousand miles distant from our own shores, but which has to assemble the raw materials for her manufactures from distances varying from a hundred to a thousand miles, by lake and railway, before she can begin to manufacture, and which, by geographical conditions, is practically compelled to carry on her manufacturing operations, not on the seaboard, as is usual in Great Britain, but far in the interior, at distances varying from two hundred and fifty to five hundred miles from the sea.

It would naturally be supposed that the establishments on the Atlantic seaboard of the United States were most likely to attempt competition with the mother country, or to succeed in the attempt. Such, however, has not been the case. The most formidable form and extent of competition has come from the neighborhood of Pittsburg, four hundred and fifty miles from New York, where the great Carnegie company has constructed, and keeps in operation, three or four of the most remarkable establishments of their kind in existence, and undertakes the manufacture of iron and steel in a great variety of different forms. This phenomenon is not more singular or interesting than the career of the man whose name the enterprise bears, and we may, therefore, be allowed to digress for a moment to speak of that career, as illustrating at once the conditions and the possibilities of industrial development on the western side of the Atlantic.

Andrew Carnegie, the founder of the firm whose operations are now regarded as a menace to Europe, is the son of a working weaver, and was born at Dunfermline, in Scotland, about sixty-four years ago. He commenced work at ten years of age as a piecer in a textile factory; then became successively a boiler-mender, a telegraph messenger, and a telegraph operator. He emigrated to the United States in 1847, becoming connected with the Pennsylvania Railroad, and in that capacity was enabled to realize the importance of having local supplies of steel rails, which were then being imported to a considerable extent from Europe for American railroad construction. Through the intermediation of some friends, he was enabled to acquire an interest, first in a small forge, next in some bridge works, and finally in the larger works which were founded by the late Edgar Thomson, late manager of the Pennsylvania Railroad, for the purpose of manufacturing iron and steel for railway purposes.

The Homestead works and the Duquesne furnaces followed the Edgar Thomson, and these were aided and abetted by the Keystone Bridge Works, giving the firm the supreme control of four of the largest and best equipped establishments on either side of the Atlantic.

It seems ridiculous, on the face of it, to speak or think of a single firm as offering a menace to the industry of a whole continent, when that industry is one so vast and universal as the manufacture of iron and steel, and that continent happens to be Europe, where modern industry has hitherto been supposed to have had the most favorable conditions for large and successful development. It appears all the more ridiculous when we bear in mind that the rival works of Europe, for the most part, have the raw materials within a hundred miles of each other, and within twenty miles of the sea.

A few figures will make this danger more appreciable. The Carnegie company alone produces nearly two million tons of pig iron per annum, which is almost as much as the total joint output of Germany, France, and Belgium thirty years ago, and more than the total iron output of the United States up to the year 1872. The same works produce annually about a million tons of bessemer steel ingots and six hundred and fifty thousand tons of rails,—figures which exceed the annual output of all the works in Great Britain up to 1880,—and the same firm has lately made arrangements to produce at Homestead about a million tons of open-hearth steel annually, which is more than the total open-hearth steel output of France, Belgium, and Germany combined, and considerably more than the total output of this description of steel in the United States, as a whole, up to 1894. And this gigantic corporation does not stand alone. The Illinois Steel Company has also much larger resources of production than any concern in Europe, and so also has the Tennessee Coal and Iron Company in another and not less interesting region. Of corporations in the second rank, but still important and formidable, the number is legion.

We may now proceed to consider some of the conditions that differentiate European, and, more particularly, British, from American competition, with a view to the ascertainment of how far either enjoys superiority of present position or future prospects as compared with the other. This inevitably leads us to a consideration of the general conditions and resources on which manufacturing supremacy reposes, and to which both countries must look for the maintenance of their industrial status.

The essential elements in the success of manufacturing competition may be thus classified:

1.—Abundance of cheap raw materials of good quality.
2.—Favorable conditions for manufacturing near to shipping ports.
3.—Cheap transport by land and water, but especially by land.
4.—Economical, but not necessarily nominally cheap, labor.
5.—Efficient technical equipment.
6.—Facilities for ready and economical distribution of products.

These conditions, again, are divisible into those that are special to particular countries or localities, and those that are common to all.

In one respect, the United States appear to enjoy conditions which are unapproached in Great Britain, but which happen to be at once vital and fundamental. They have the most ample abundance of cheap and high-class ores at an extremely low price. In the northern States of Michigan, Minnesota, and Wisconsin, commonly spoken of on both sides of the Atlantic as the Lake Superior region, the American iron trade commands the largest supplies of high-class ores known to exist in the whole world. These ores occur under conditions which admit of their being mined at a lower cost than is known anywhere else. They have, however, one great natural drawback; they are hundreds of miles from suitable fuel. A quarter of a century ago this fact would have hindered their economical use in the iron industry, and actually did produce that effect, until the problem of cheap transportation had been solved. There remained the question of whether the ore should be carried to the fuel or the fuel to the ore. Nature seemed to have dictated the reply. At Pittsburg, at the junction of the Ohio with the Allegheny and Monongahela rivers, on the most productive coal-field in the new world, and having all the advantages of a great railroad center, and of numerous subsidiary industries, there were manifestly unexcelled facilities for distribution, and thither, therefore, the steps of some of the pioneers of the modern fabric of American industry were directed. Others, again, adopted Chicago as a more suitable center for manufacturing operations, although nearly five hundred miles from both the ore and the fuel, because of its importance as a market and a distributing center, and because of the ready command of effective labor. A third group adopted Philadelphia as a manufacturing center, because it was near to shipping facilities and a dense population, and suitable alike for fuel supplies and for export trade. A fourth group of works located at and around Birmingham in Alabama, obviously because on that particular spot the iron ores and the fuel could be assembled within a radius of twenty to thirty miles, although the nearest port for shipment was two hundred and fifty miles distant, and there were no large local markets near at hand. Of the numerous minor groups of works in the United States it is hardly necessary to speak, beyond remarking that there is every likelihood of a considerable iron industry springing up on Lake Erie, at or near to the beautiful modern city of Cleveland, where materials can be assembled at a relatively cheap cost, and a reasonable export rate is possible *via* the Erie canal.

The most important of these groups depend on the ores of Lake Superior, as mined in the Mesabi, the Vermilion, the Gogebic, and

other ranges, and during the last few years have been having 60 to 65-per cent. ores delivered at works, after a railroad transport varying from 40 to 150 miles, and a lake transport varying from 500 to 850 miles, at three to five dollars per ton, whereas no British works can command such ores at anything like the lower figure named. The Alabama and Tennessee works command a 40 per cent. ore at 2s. 6d. to 4s. 6d. per ton at the furnaces, which is under the prices paid in the Cleveland and other cheap low-grade ore districts in Great Britain, and in Germany and Belgium for the oolitic ores of Luxemburg and Lorraine.

So far as labor is concerned, the achievements and the experience of the United States have completely upset the fallacy that highly-paid work is necessarily dear. On the contrary, it has been made evident that nominally dear labor is the cheapest of all, if its efficiency be guaranteed by proper methods and appliances. There are no works, either at home or abroad, where ores, coal, pig iron, and steel ingots, or steel girders, rails, and beams, are being made at so low labor cost, per ton of product, as in the United States; and yet there is no iron-making country in which the nominal wages paid to labor are so high. The explanation of this paradox consists in the fact that the American workmen do not, as is but too usual in Europe, and especially in Great Britain, resist mechanical improvements, but rather welcome them, as assisting to get rid of the most irksome and laborious part of their duties. Most of the operations are conducted automatically by machinery of a novel and ingenious character, which British manufacturers, I have reason to believe, hesitate to introduce at home, because of possible difficulties with their workmen.

In their dealings with their workmen, as in all other operations involved in the conduct of their colossal undertakings, the Carnegie Company, which I select as a type of American methods, has adopted a firm and determined, yet not aggressive, attitude, which would, I fear, be declined by even the largest concerns in Great Britain. In a communication which I have received from Mr. Carnegie, he explains that their system has been to run their works, as regards labor, on a three-years' sliding scale, the basis of which has been a matter of tri-yearly settlement. Each month a committee appointed by the workmen visits the offices, and is shown everything connected with the contracts executed or pending, being at the same time supplied with a statement showing the net prices received for the work of the previous month. These prices govern the wages paid in the following month.

Of course, the system, however well devised, has now and again been on the verge of break-down by reason of changes intro-

duced into methods or systems of manufacture. Now and again, for example, the Carnegie Company has taken advantage of newly-designed labor-saving appliances, and hence has raised the issue of what the effect of such a change should be on the previously-existing arrangements with their workmen. This company, on the expiration of the three years' scale in January, 1892, submitted a proposal to divide equally with their workmen all the increase of profits or net earnings due to improved methods. The proposal was accepted by the workmen at the rail-mills, but was declined by those at Homestead, and hence the memorable strike of that year, the exact circumstances of which were greatly misunderstood.*

Efficient technical equipment has been spoken of as one of the essential elements in the success of manufacturing competition. Until a comparatively recent date, Great Britain stood unrivalled from this point of view, and was, indeed, *sui generis* as a manufacturing nation. But the economic policy adopted by the United States—and which is often supposed to cramp and fetter invention—did not hinder a band of brilliant engineers and metallurgists from exerting themselves to improve upon British methods and appliances, until they placed American practice far ahead of anything in Europe. It is hardly needful to multiply examples of this well-known fact—a part, by the way, seldom disputed now even by the most conservative of British manufacturers. American methods enable much larger yields to be obtained from a given plant, alike in iron-works and in steel-works, and generally at a lower labor-cost. Fortunately for Great Britain, she has awakened to the importance of getting abreast of American practice, and is now endeavoring—although still, as a rule, at a more or less considerable distance—to approach, or rival, America's mechanical achievements.

Again, it goes without saying that facilities for the distribution of manufactured products are greatly helpful, if not fundamental, in the maintenance of industrial supremacy. So far as foreign or export trade is concerned, no country should be better off in this respect than Great Britain. Nevertheless, it seems to be the fact that high railway rates, and the arrangements made by shipping conferences, have deprived that country of a great deal of the superiority which unrivalled geographical situation should guarantee. Even these conditions, however, do not prevent Great Britain from using the facilities which she enjoys as a nation owning and controlling one-half of all the shipping tonnage of the world, and her export trade in manufactured com-

*The truth is that the Carnegie Company asked only that the "tonnage" men, who numbered only 300 out of about 3,800 in and around the works, should divide these increased net earnings. The attitude taken by the firm has been described as an attack upon organized labor. It was nothing of the kind. It was only a stand made for freedom of contract, and resistance to violence. But the trouble given by the union workmen was so great that the company has since largely worked its plants with non-union labor.

modities is still consequently larger than that of any other country. In the absence of similar facilities, the United States stand at a great disadvantage. They cannot always command tonnage, and they cannot control freights as can Great Britain. This disability is likely to remain, while the American marine, on the over-sea register, remains so greatly inferior to the British merchant navy, as it now is.

Perhaps, however, the more immediate cause of the industrial movement which has now alarmed Europe so seriously is the recent development of the new ore deposits in the Lake Superior region, which has placed at the disposal of certain manufacturers raw materials of exceptional richness, at a price that would not have been deemed possible only five years ago. Although I shall return to this subject, I may here remark that, according to the American census of 1880, the average spot value of all the ores mined in the United States in that year was 12s. per ton, and the average of the Lake Superior ores was 13s. 7½d. per ton. A dollar and a half more, or, say, 6s. per ton, would be required to place these materials alongside furnaces in the Pittsburg district, so that the average cost of a ton of Lake Superior ore, at the furnaces in Pittsburg, would not be less than 19s. per ton, and the average cost of the single item of ores, per ton of iron produced, would be about as much as the total cost of producing a ton of bessemer pig iron in the same district, according to the most recent figures. This cost is now considerably under the average of the European, including the British, iron-making centers, producing the same description of iron.

This extraordinary change has been brought about, partly by the opening-up of the new Mesabi iron range, partly by improved methods of working and distributing the ores, and partly by large reductions in the cost of transportation. It is claimed that over a large area the Mesabi ores can be put on trucks at the mine for only 7d. per ton, excluding royalties, as against 13s. 7½d. for Marquette ores—then almost the only ores worked on a large scale in the lake region—in 1880, and the ores are almost of equal richness. The distance over which these ores have to be carried, in order to reach the blast furnaces for which they are destined, is, of course, very considerable, but, by conducting operations on a specially large scale, and studying every practicable economy, the cost of transport has been reduced to little more than a dollar a ton for an average haul of about eight hundred miles, which is probably the lowest rate that has ever been known, on a practical basis, in the history of modern transport.

Briefly, this cheap transport may be here ascribed to a relatively low capital cost; to the use of powerful locomotives, capable of hauling very large loads; to the employment of trucks that

carry thirty to forty tons each, against a capacity of eight to ten tons in British trucks, thereby securing a relatively large paying load; and to numerous minor economies. I may here add that the average cost of railroad transport in the United States is estimated at not more than one-third of the average in Great Britain.

So far as the question of the problematical continuance of the present low range of prices is concerned, it must not be overlooked that each succeeding period of depression in the history of the American iron trade has discovered a lower depth, in what was previously deemed to be the lowest depth possible. Take bessemer pig iron as a case in point,—this being virtually the basis of the American iron and steel industry. In the period 1873–79 the lowest price known for this product was $19.50, and that price was then deemed to be all but impossible. In the next serious depression, 1884–85, the price of $17 was reached; and in the period 1891–94 the lowest price was $10.50. But during the last twelve months considerable quantities of bessemer pig iron have been sold for less than 40s. per ton, or 6 to 8s. per ton more than European rates; and it is claimed that under present conditions pig iron can be made at Pittsburg for less than 35s. per ton, or, approximately, 10s. per ton below its estimated cost in Europe. It has been much the same with other leading commodities—steel rails, for example, having been regarded as phenomenally low at $40 in the period 1873–79; at $26 in the period 1884–85; and at $24 in 1891–94, but being now sold at $17 per ton, or less, at works in Pittsburg.

I have said that American practice has confounded the wisdom of those who have hitherto argued that nominally cheap labor is needed to secure an absolutely cheap product. It has equally upset the old-fashioned ideas about the effect of protection in favoring the producer at the expense of the consumer. No doubt, under ordinary circumstances, and especially in the infancy of industry, this result happens. It may also sometimes happen, and remain, after an industry has been fully established, when the conditions are not favorable to cheap production as a result of internecine competition. It has happened also, and will probably happen again, as the result of artificial interference with the free play of competition between the works established in the country whose industries are supposed to be protected. But over a wide range of industrial operations protection does not protect, and this paradox was never more clearly apparent than in the existing condition of the American iron industry. For that industry at least the United States require the shackles of protection no longer. I am disposed to doubt whether the same remark is equally true of European countries.

MODERN WHARF IMPROVEMENTS AND HARBOR FACILITIES.

By Foster Crowell.

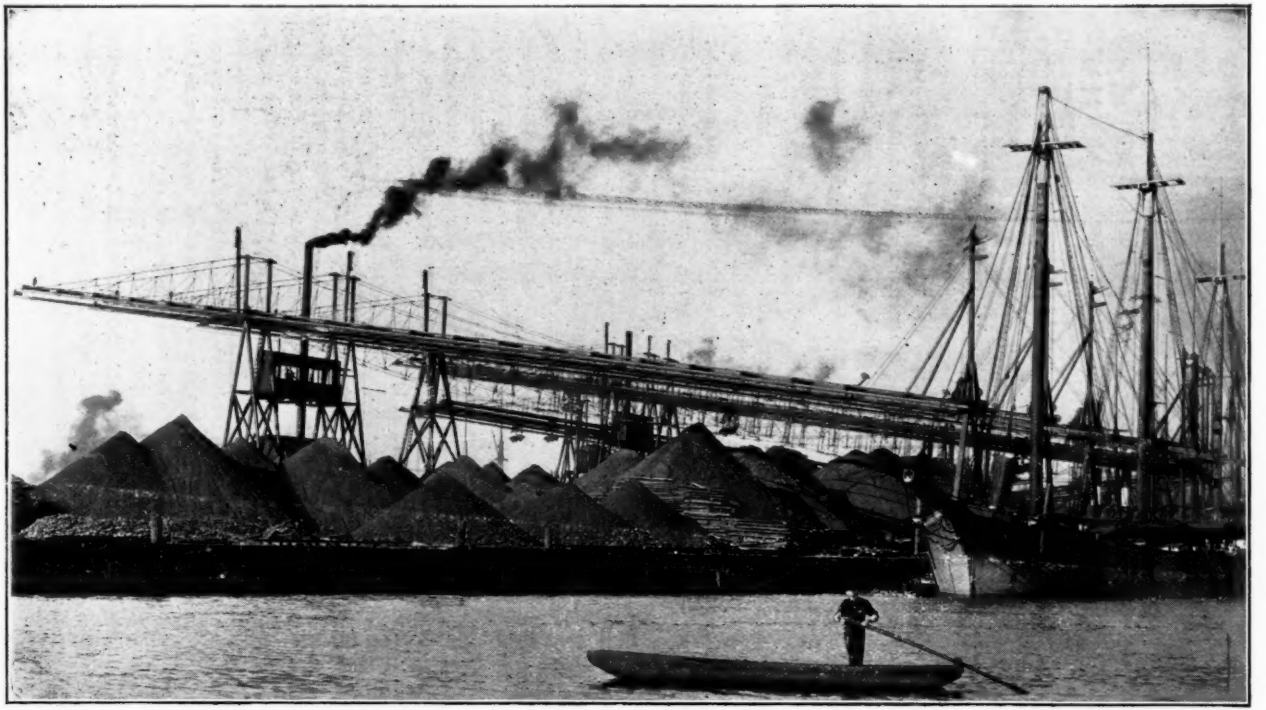
II. EXPANSION OF DOCKS, WHARF SHEDS, AND MEANS OF TRANSPORTATION.

IN the first paper of this series (published in the October number) various kinds of maritime plants for handling miscellaneous cargoes were described and illustrated; we come now to the development on a larger scale of typical apparatus for handling commodities in large bulk, wherewith great rapidity of action and low cost of operation can be attained.

In the matter of cost of operating wharf plants it is not to be understood that the same degree of economy which can be reached in the handling of a particular commodity in large bulk, such as coal, or grain, or ore, can be attained with miscellaneous cargoes; the difference in cost per ton may be enormous. For instance, there are plants in successful operation at Charleston and other places, for unloading sulphur, barytes, and other bulk stuff, at a cost of less than two cents per ton, including the entire movement from the vessel's hold to the storage bins, several hundred feet away from the wharf, and thence through chutes to the cars; whereas the cost of handling a miscellaneous cargo, even under the most favorable circumstances, ranges at present from thirty-five to ninety cents per ton between hold and wharf. It is in the methods of dealing with general cargoes that the greatest field for improvement exists; this is not a stevedore's, but an engineer's problem, and it embraces things other than the actual placing of the goods; it involves their sorting and distribution, and must be adaptable to all sorts and conditions of freight.

Coal can be handled very cheaply; under certain conditions hard coal can be put into a vessel for less than one cent per ton; but the best performance in New York harbor in coaling a ship at the wharf used for miscellaneous traffic costs from twenty to twenty-five cents per ton. A fortune awaits the inventor who can devise a practical and economical mechanical means of loading steamer coal in the condition in which it comes to market,—a mixture of large lumps and fine dust and all intermediate sizes and shapes.

In the lake ports and at some seaports—wherever coal can be brought direct from the mines to the ship's side in the cars—the problem of coaling is much simpler. Plants are in use where the loaded car is run into a side-tipping cradle placed at a higher eleva-



MOVABLE BRIDGE-TRAMWAY HOISTING AND CONVEYING APPARATUS, FOR THE RAPID HANDLING OF COAL AND ORE, IN USE ON THE C. & P. R. R. CO.'S DOCK, CLEVELAND, OHIO.

Built by Brown Hoisting and Conveying Machine Co. Clear span, 180 feet. Cantilever extension, 80 feet. Hinged projection over vessel, 34 feet. Total length of tramways, 300 feet. Height above dock—front piers, 30 feet, back piers, 53 feet.

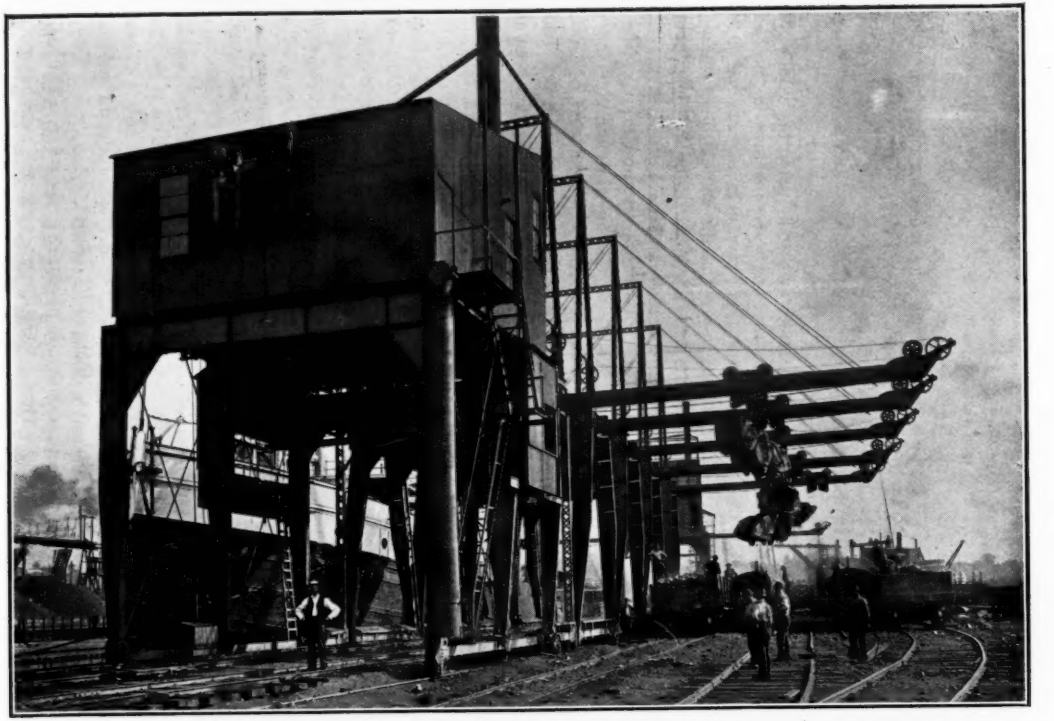
tion than the ship's hatches, and the cradle is then revolved in a vertical plane, discharging the entire car load in an instant into the hatch, the complete operation requiring about three minutes per car, on an average,—a rate of twenty cars, or five hundred tons, per hour. There are other forms of tipples similarly used, and also arrangements for drop-bottom cars.

The statement has been made that a lake propellor some time ago unloaded 3,000 tons at Erie, steamed to Ashtabula, forty miles away, and took on 1,800 tons of coal, entering and clearing at both places in one day; it is also claimed that 5,000 tons have been loaded at one wharf in twelve hours.

As is the case always with machinery, the theoretical minimum of cost of operating can be reached only when the machine is worked full time; therefore figures of unusual performances must be weighed with care. It may be said that the cost at the lake ports by the old methods is about twenty-five cents per ton from car to hold,—just about the same as the cost from barge to bunkers in New York harbor.

The Brown Hoisting and Conveying Company, of Cleveland, has kindly furnished me figures, collected by the superintendents of various companies using their forms of apparatus, of the cost of work done by their bridge tramways, handling ore and coal from vessel to dock, as well as from cars to vessel; these reports extend over several years, and embrace more than fifty loadings of various steamers and other vessels in the lake trade, with cargoes of ore and coal ranging from 4,569 tons down to 1,016 tons, at the ports of Cleveland, South Chicago, West Superior, Erie, Fairport, and Duluth. A comparison of the figures shows that the largest single cargo was unloaded in 11 hours at the rate of 415 gross tons per hour, and that the average hourly rate of all was 226 gross tons. The cost per ton cannot be properly averaged in the same way, but, from an actual account of the expenses of operation, carefully kept for an entire season, of a plant consisting of three bridge tramways, it is found that, worked only three-fourths of the number of working days, at a rate of 1,000 tons per day for the three, the cost would have been 1.6 cents per ton; if the machines had been worked every day, the cost would have been reduced to 1.32 cents per ton. The illustration on page 206 shows the Brown bridge tramways in operation. On page 208 is shown another form of the Brown movable conveying apparatus in use on the C. & P. R. R. Company's docks at Cleveland, Ohio.

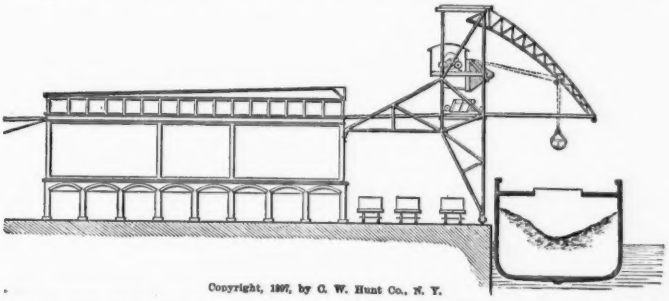
The longitudinal section shown on page 209 gives a very clear idea of the method used by the Danish Coal Company at the new free port of Copenhagen, the apparatus being designed and manufactured by the C. W. Hunt Company, of New York. The coal is received in



CONVEYING APPARATUS FOR THE RAPID HANDLING OF COAL AND ORE, IN USE ON THE C. & P. R. R. CO.'S DOCKS, CLEVELAND, OHIO.

The Brown Hoisting and Conveying Machine Co. Tramway projection over vessel, 30 feet. Cantilever extension over tracks, 33 feet. This plant extends over four railroad tracks, so that cars can pass beneath. The entire plant is movable parallel to dock front.

ships, and is removed by means of the steam shovel, operated by a specially constructed hoisting engine, shown in the illustration on page 211. The shovel has a capacity of two tons of coal at each load, and a round trip to the hopper in the tower and return to the boat is made in less than one minute. The shovel is hoisted by a flat-link chain, composed of eight side-by-side links, each link being stamped from special flat steel, and the chain has a tested strength of 62,000 pounds, while the total strain in practical working is from 8,000 to 10,000 pounds, giving an ample safety factor. The use of this chain eliminates all possibility of accidents from defects in welded links, such as are occasional with crane chains. The elevators are movable the whole length of the wharf, one leg resting on a rail on the wharf and the other on a track placed on the coal storage building, leaving unobstructed space for three railway tracks. They are arranged so that the coal, when hoisted from a vessel, can be carried



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COAL-HANDLING PLANT OF THE DANISH COAL CO., NEW FREE PORT OF COPENHAGEN.

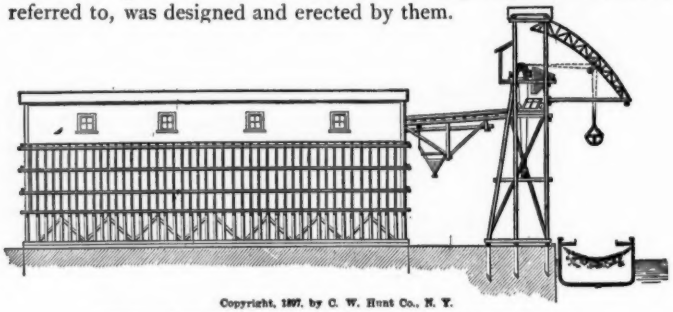
into the building by the over-head automatic railway, whence it can be spouted directly into railroad cars underneath on the wharf; or it can be dumped into a lighter on the outside of the coal vessel. There are four of the elevators and engines in the plant, similar to the one shown. The engine illustrates the type especially designed and adapted for this purpose. There are two cylinders, each 12 inches in diameter and with a stroke of 14 inches. The reversing valve-gear is the "Hackworth," and is simple and efficient. The chain winds up on itself on the drum in a spiral as flat as a wire rope, and almost as noiselessly. The umbrella-shaped drum at the left of the engine holds the wire rope for raising and lowering the counter-weight to balance the weight of the shovel.

After the coal is dumped into the hopper in the tower, the automatic car, with a capacity of one shovel-load of 2 tons, carries it, by gravity, to any desired location in the coal-storage building, dumps

there its load automatically, and returns to the starting-point without any manual labor, the entire trip occupying about thirty seconds.

A somewhat similar arrangement, shown by the section below, and also illustrated by the view on the opposite page, is that used by Mr. J. T. Story, at Morgan and Johnson avenues, Newtown Creek, Brooklyn. This, too, was designed and erected by the C. W. Hunt Company. It differs from the Copenhagen plant chiefly in respect to the elevator, which is not movable. The shovel carries two tons of coal, and makes a trip a minute.

The automatic method of returning the car to the loading point, after automatical dumping at any desired point, has been applied by the C. W. Hunt Company to handling various commodities besides coal. The plant at Charleston, for unloading sulphur, etc., above referred to, was designed and erected by them.



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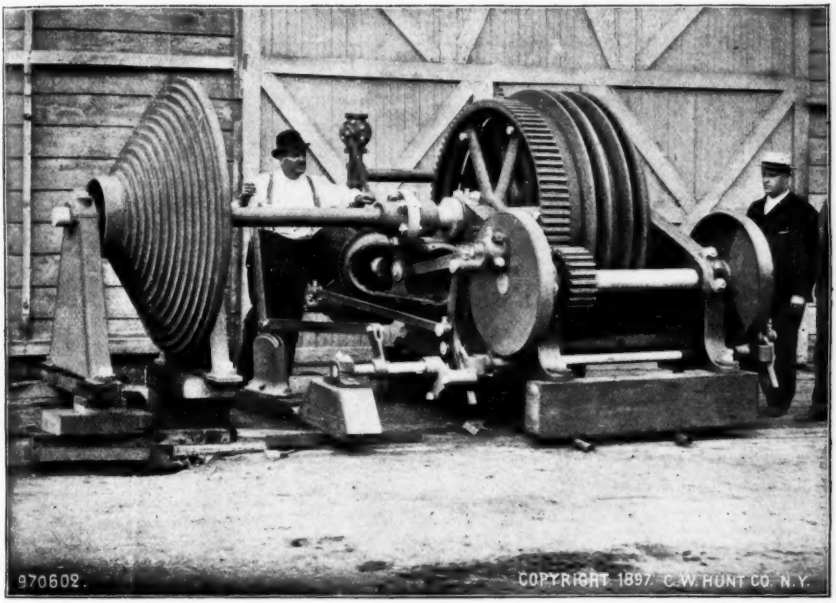
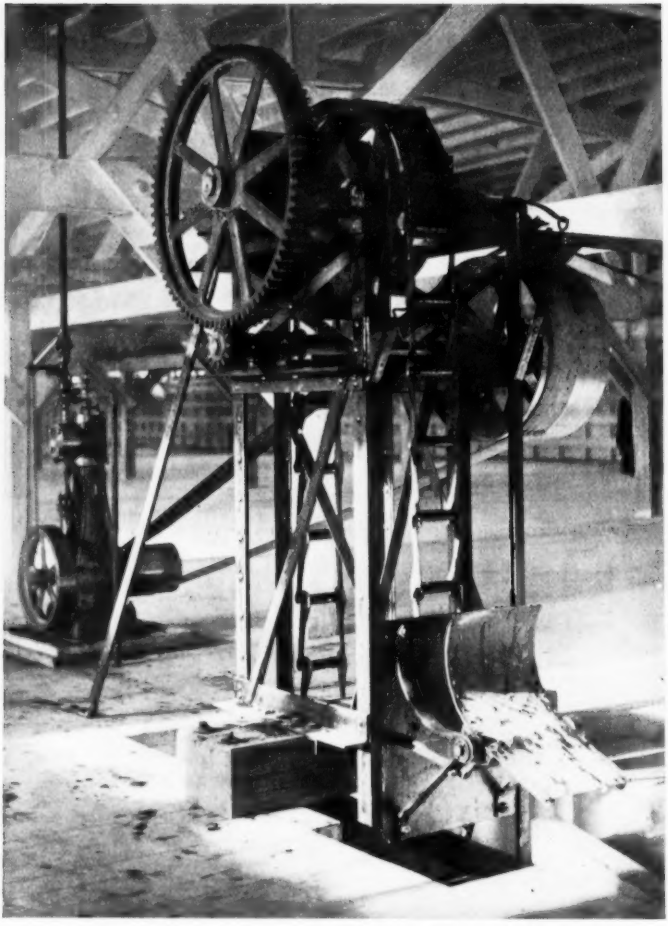
NEWTOWN CREEK COAL-HANDLING PLANT, BROOKLYN, N. Y.

Handling of package freight, as already suggested, is almost of necessity a more expensive operation; but much has been done here also in the effective designing and installation of labor-saving machinery. Such are the "ramps," or traveling-platform conveyors, provided with suitable devices for raising or lowering them to suit the changes in tide or the height of a vessel's freeboard, onto which the package may be delivered or the trucks wheeled and the whole quickly carried to the desired discharging point. Plants of this character have been installed by the Link-Belt Engineering Co. at Boston, Chicago and New Orleans, and six will shortly be in operation at the Buffalo, N. Y., terminus of the Northern Steamship Co. On page 212 is shown an automatic lift for barrels or sacks, erected by the Link-Belt company on the Erie Railroad double-decked pier on the Hudson river. The carriers are driven by a single-strand chain, and a trip tilts them automatically and discharges the barrels or sacks with accuracy either on the upper deck, when elevating, or on the main deck, when lowering—the latter service being effected by reversing the motion of the chain.



THE HOISTING ENGINE FOR THE INSTALLATION OF THE DANISH COAL CO.

COAL-HANDLING PLANT AT NEWTOWN CREEK, BROOKLYN, N. Y.



AUTOMATIC HOIST FOR BARRELS OR SACKS, ERIE R. R. PIER, HUDSON RIVER.

While the development of wharves, separately, by a city, is not conducive to the best results, there are certain provisions on a grand scale, which also are necessary for the purpose, that can be properly done only by the port collectively. Among these the extension of railroad tracks from all the lines entering the port to a connection with all the wharves is of paramount importance. When such con-

nections have been attempted by the railroads themselves in certain cities, they have been frustrated by the authorities or effectually opposed by the people. The effect in such cases has been to drive commerce away to other places, or else to lay a heavy burden upon it in excessive cost of loading and unloading. In New York harbor the introduction of the car-float has rendered it possible to bring the cars to some of the wharves by water, but, as a rule, wharves so served are those belonging to the railroad companies, and there is no general system of rail-connections, although a limited portion of the North river front is traversed by steam tracks of a railroad company. The board of consulting engineers of the commissioners of docks recently has recommended a public extension of railroad tracks along the wharves from a landing-place to be reached by car-floats; it is proposed to connect the tracks with the piers by spurs, and also with warehouses and other establishments.

Such an arrangement, under proper regulation, could not fail to be advantageous to the port, as well as to individual shippers. It is astounding that in the United States, wherein the railroad has had its highest development and most extensive application, the greatest seaport should be destitute of so obvious a necessity as the simple extension of the tracks to the wharves, for the common good. Logic alone would call for it, even were not the European ports full of convincing examples.

For an interesting instance we may turn again to Glasgow; there the problem of a universal rail-connection has been well solved, and in such a way, too, that the most advantageous portion of the river for a public park, extending for more than a mile, has been left for the beautiful Glasgow Green. The rail system is such that every dock and quay is connected with the entire kingdom, and in communication with the splendid outfit of steam and hydraulic cranes already described. Another interesting example of rail-connections to docks is at Marseilles, page 221; the most extensive of all, perhaps, is that at Hamburg, page 220.

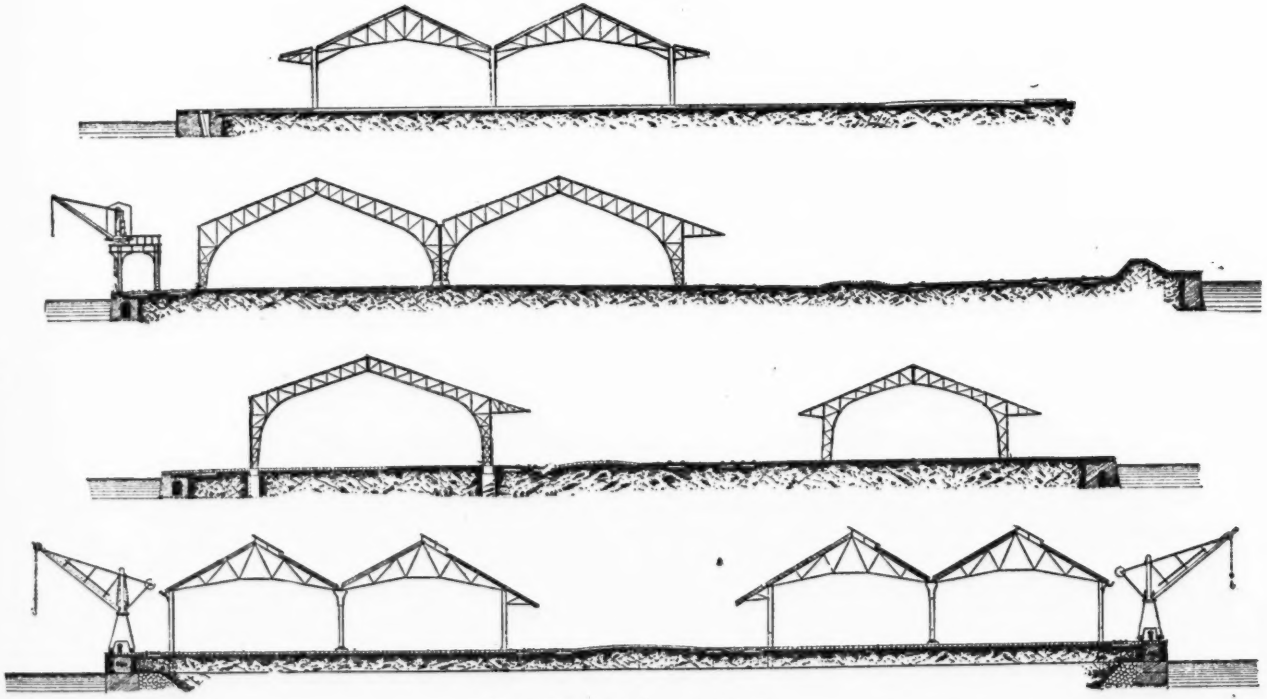
In the United States developments of this sort are usually made, if at all, by private corporations; there is doubtless no reason why a terminal company, properly organized and controlled, could not give adequate service, but the prejudice against this particular form of the use of public streets, illogical though it may be, is so strong that the city will probably have to assume the matter entirely.

There is no denying the fact that the use of marginal streets for railway tracks on the surface seriously interferes with the present uses by wagons and trucks and pedestrians; on that account the elevation of the tracks naturally suggests itself, especially in situations

where contiguous streets are likewise affected; but, the expense of elevating the entire system of tracks and warehouses being very great, and the inconvenience arising therefrom being considerable, it will usually be found better to keep the rail traffic on *terra firma*, and elevate the rest, excluding all but that which pertains to the wharves. It is ridiculous to make a thoroughfare of a quay, yet that is what is usually done. To remedy present conditions, and depart from long-established usage, requires radical treatment of a very broad nature, which the city alone can well undertake. To quote from Mr. Black's article on "New York's Commercial Blight," published in this magazine several years ago: "It is hard to say who conceived the idea of an exterior street. If he was an engineer, he should have been hanged; probably he was a truckman."

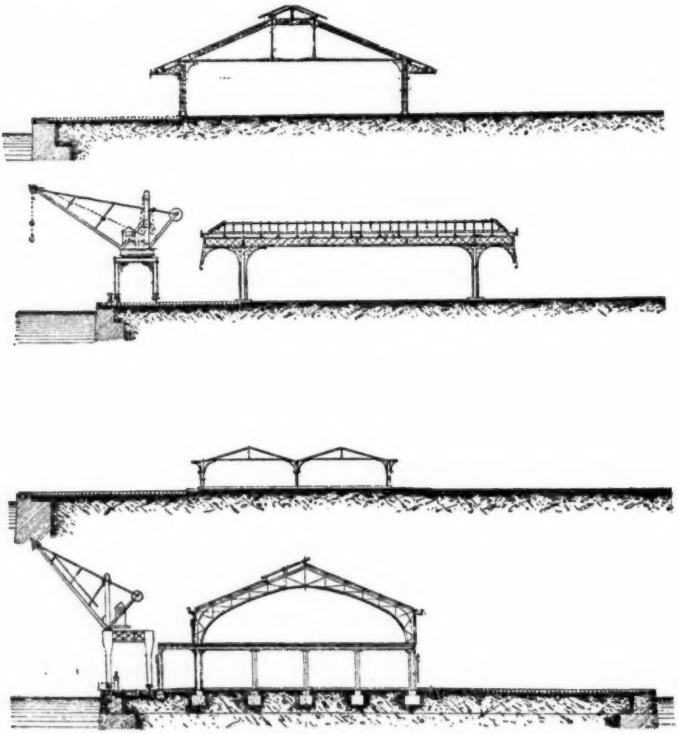
It seems, moreover, as if that truckman was responsible for a good deal else that is inconvenient and costly and absurd in connection with handling goods in transit in New York city. If we were to take a case of foreign goods, in almost any line of business, and follow it, we should find that, after being landed, it is put upon a truck and carted a long distance, either to a bonded warehouse or to the importer's store, where it is re-marked, re-invoiced in United States measures, and carted slowly a long distance back again to railroad or steamer. A very large part of the enormous street traffic which congests down-town New York is composed of conflicting lines of heavily-laden vehicles engaged in this ridiculous occupation of giving the goods two costly journeys which would be utterly needless were warehouses provided at the wharves. Much, if not most, of the goods in transit do not even need warehouses as business is conducted, properly-built sheds on the wharves being more convenient as well as entirely adequate. But much more wharf-space would be needed than is at present provided; not more room for vessels, but greater width and space for the wharves themselves. Here again Americans are wofully behind the times. The subject is so simple that it is hardly necessary to describe in detail what is done elsewhere, but the illustrations of the types of sheds in use in Germany and France are worthyof study.

The question of the proper proportion of berths and wharves, and of their respective widths, is an intricate one, involving many considerations and far too many figures to be gone into very fully here. Given a certain length of shore line, the question first to be determined is how many separate wharves will best develop its capacity. The number depends somewhat upon the special branches of commerce to be provided for, but chiefly upon the space needed for sheds and the provision of loading—and unloading—appliances and track-systems for moving the goods. These provisions are so costly to in-



FRENCH EXAMPLES OF QUAY SHEDS.

The top cut is a section through the quay at Calais, the second and third at Havre, and the lowest, at Marseilles.



EXAMPLES OF FRENCH QUAY SHEDS.
The top section is at Dieppe, the second at Rouen, the third at Bordeaux and the lowest at Marseilles.

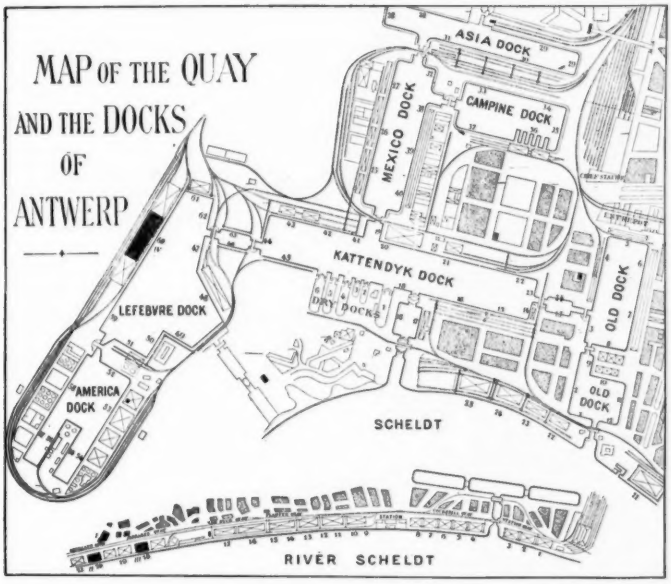
stall that it is desirable to have the same plant serve as much quay-front as possible, and, in order to avoid unnecessary duplication, the grouping of wharves about basins becomes a natural development. But the basins take up much room laterally as well as lengthwise, and, where there is a marginal street, such development is impracticable, excepting by pushing the pier line farther and farther out into the water-space, to the disadvantage of the harbor. Here we have another objection to the marginal street system.

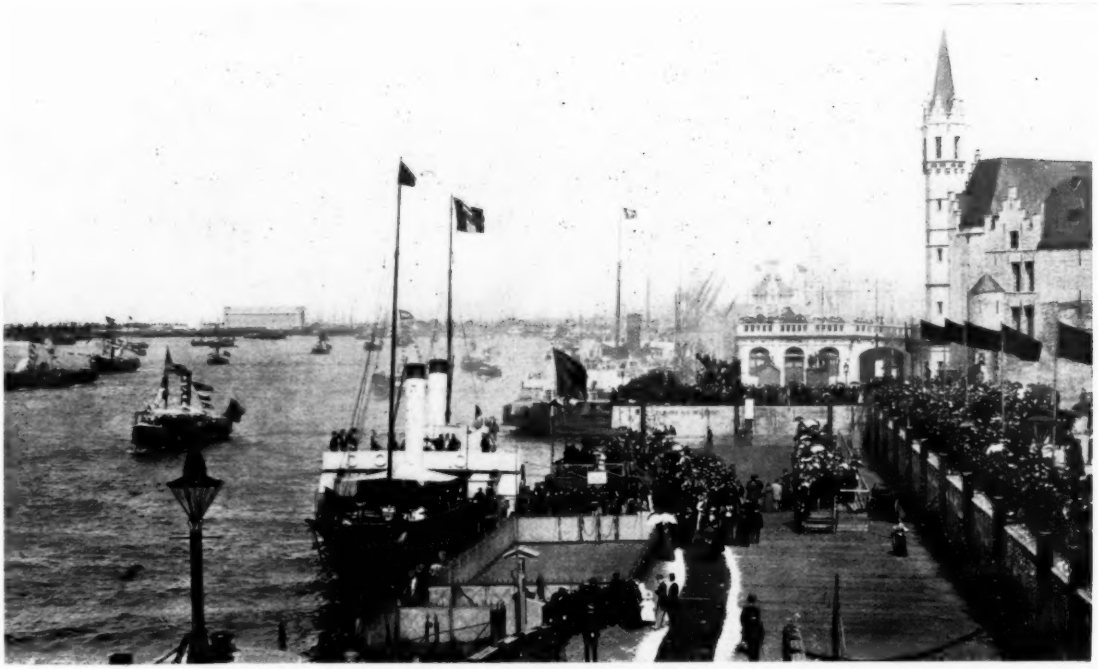
If each wharf shall be so adequately provided with cargo-handling devices and with ample storage sheds and railroad track facilities that the maximum mechanical limit of speed in loading and unloading can be attained, vessels will need to remain only the minimum

time at the wharf. But this assumption carries with it another,—*viz.*, that there shall also be repair docks, placed so that the vessel need not lie at the commercial wharf while refitting.

One of the finest examples of a concentrated dock system is at Antwerp, the chief port of Belgium and the second of the continent. As is well known, this is not a seaport in the strictest sense of the word, being on the river Scheldt, sixty miles from its mouth; but the entire river is so deep and well lighted that the port can be approached at all hours, and vessels of the largest size and drawing twenty-six feet of water can come up at night. In the daytime vessels of any draught can come up at high water. The quays allow vessels with twenty-six feet draught to moor alongside, there being everywhere sufficient water at low tide; they have a total present length of 3,500 meters (2.17 miles), and are being extended for a further length of 2,000 meters; they have a breadth of 100 meters (328 feet), with movable hydraulic cranes on railroad tracks for discharging and loading the ships.

Sheds 150 feet in width are built along the quays and four railroad tracks extend alongside, upon which the goods are conveyed to and from the railway station. There are eight docks also with railroad





CELEBRATION IN HONOR OF THE OPENING OF THE ANTWERP DOCKS.

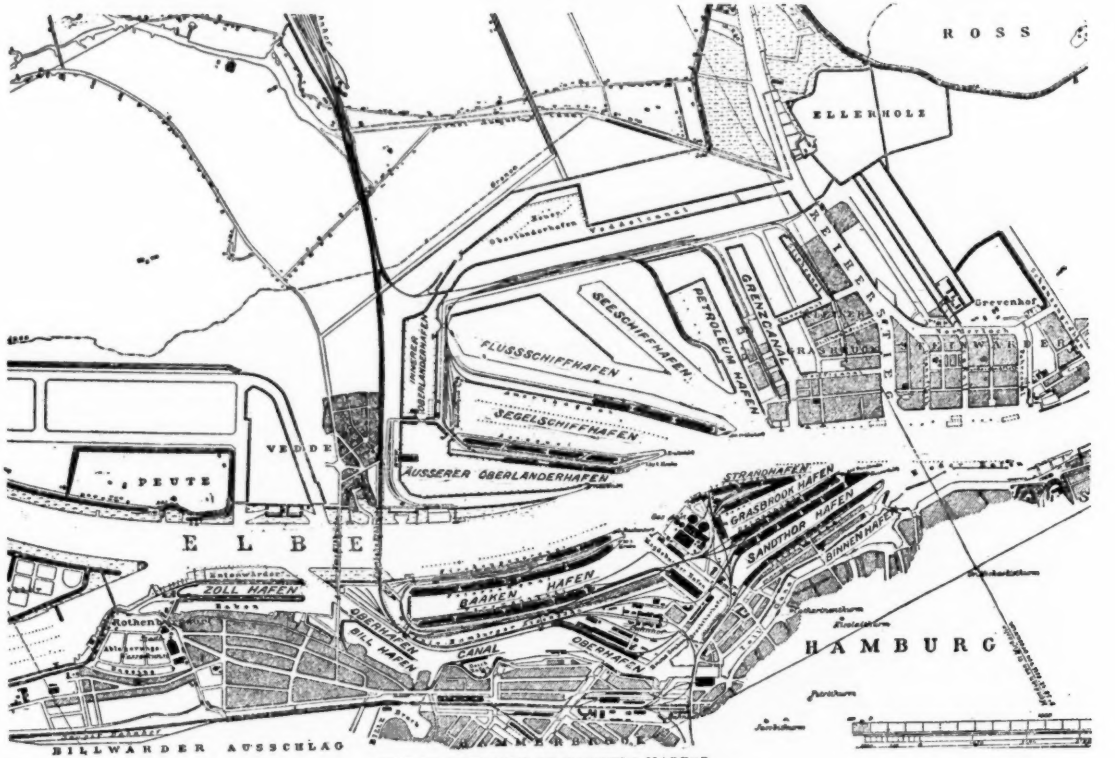
tracks passing around them, in communication with the trunk lines, while spacious sheds are disposed along the dock-fronts. Moving on rails around the docks, all of which communicate with one another, are hydraulic cranes, each of 1½ tons, besides one fixed crane of 120 tons, two of 40 tons, one of 20 tons, and one of 10 tons; in the Asia Dock spacious railway quays are provided to discharge steamers loaded with ore, and in the same dock another quay is adapted for loading coal by hydraulic cranes; in the Kattendyk Dock are six splendid dry-docks, one of them being capable of receiving steamers 475 feet in length. The sheds on the quays are placed at the disposal of the commerce, free of any charge during five days before the arrival of the ship and during the loading, after which time a charge is made, graduated for successive periods of time. Ten tugs belonging to the town are continually under steam in the docks, from 6 A. M. till 7 P. M. for moving ships, at an expense of 60 francs ($12 or 50s), and for towing ships up to 1700 tons from one end of the docks to the other. In 1896 the total tonnage movement of the port of Antwerp was 5,280,669 tons, carried in 4,136 steamers and 532 sailing vessels; the tonnage movement of New York, with its 50 miles of quayage, for the same year was 13,464,398 tons, in 5494 steamers and 2949 sailing vessels.* That is to say, in New York two-and-one-half times the tonnage presumably needed ten times the quayage of Antwerp; or, to put it somewhat more concisely, the relative efficiencies of the Antwerp and New York systems are as 4 to 1.

Another very interesting development of a concentrated dock system is at Hamburg, also a river port, where the narrow width of the Elbe has called for a special disposition of the dock entrances. The map on page 220 gives the general features of the Hamburg layout, whose splendid outfit of quay cranes has already been described and illustrated. The examples of French developments given in the illustrations are all of seaports, and each has evolved in harmony with its topography and available space.

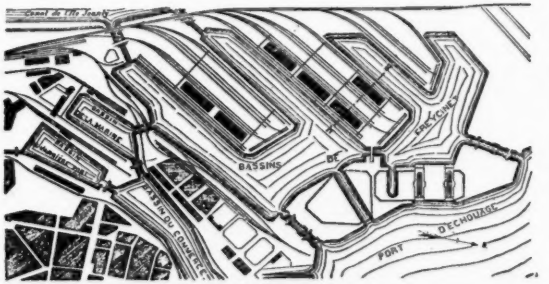
Perhaps the most notable of all the harbor enterprises in the world, and to the engineer one of the most interesting, is that which has made of Glasgow, situated far inland on a narrow, crooked, and at one time unnavigable stream, one of the chief ports of Great Britain,—a work which has extended through more than three centuries. Mr. Deas, the chief engineer of the Clyde Navigation, under whose skilful direction much of the modern part of this great task has been performed, has written a very valuable paper on this great engineering accomplishment,† from which the brief description here

*Annual Report of New York Chamber of Commerce, 1896-97.

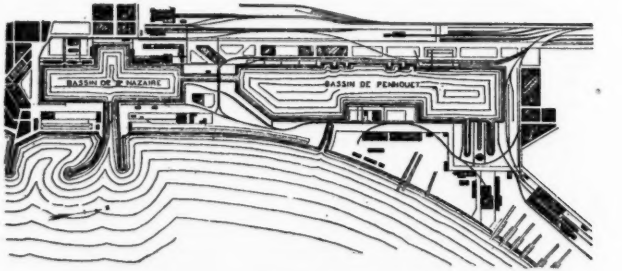
†Trans. Am. Soc. C. E., Vol. XXIX.



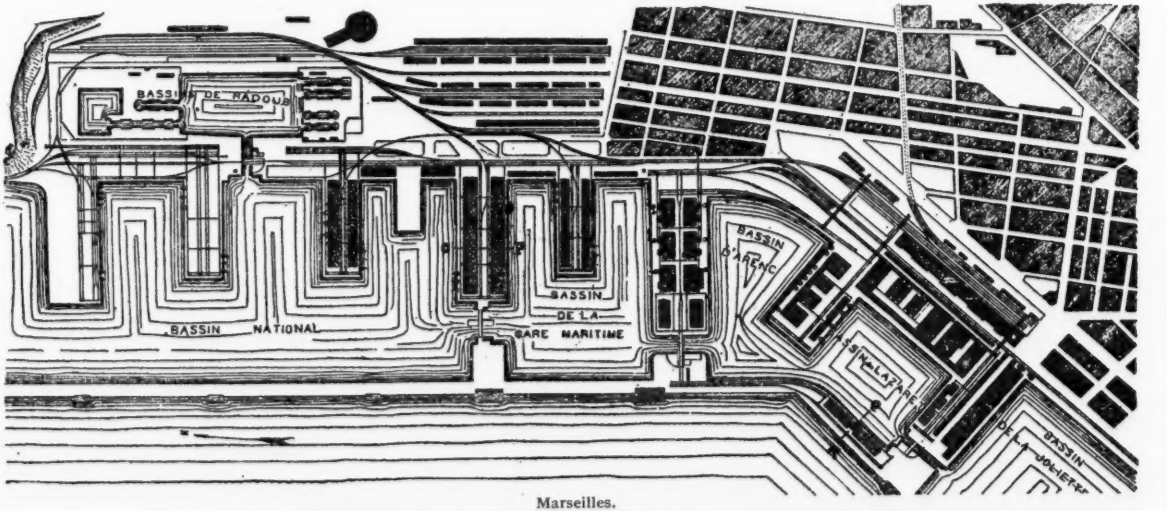
MAP OF A PORTION OF HAMBURG HARBOR.



Dunkerque.

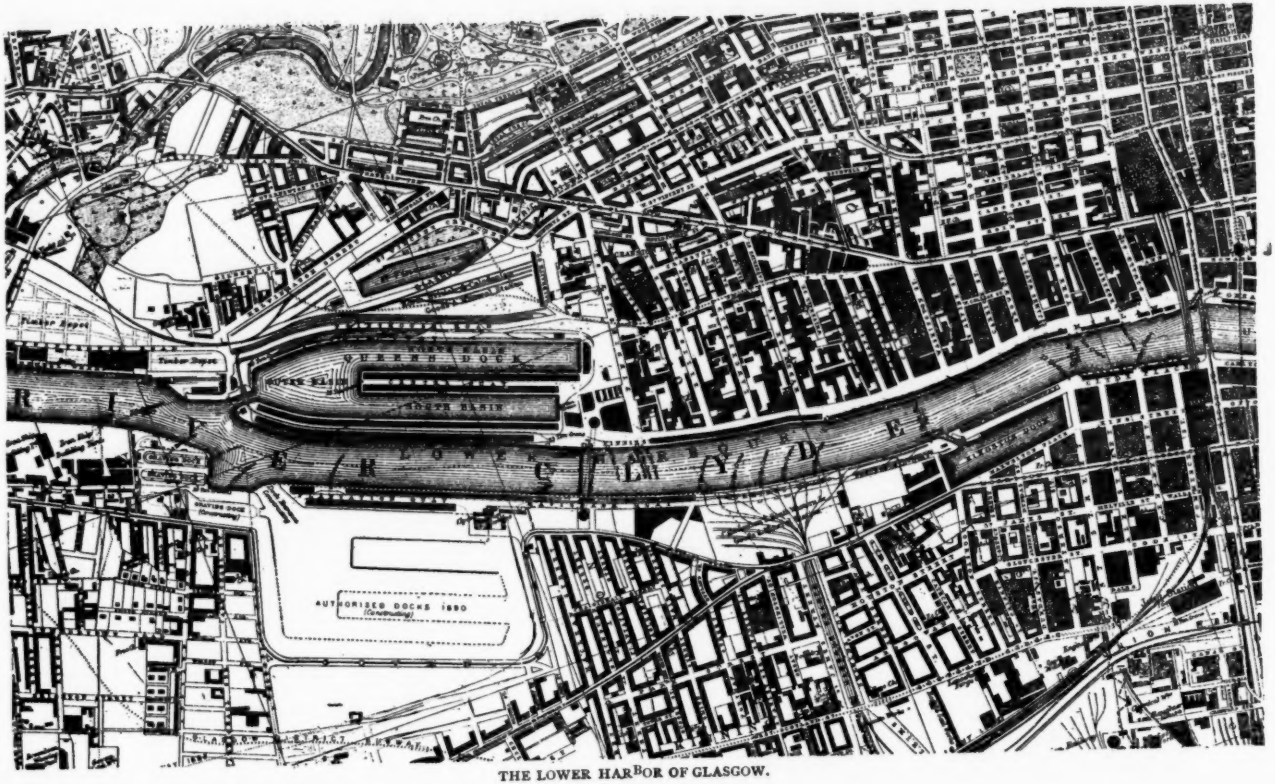


St. Nazaire.



Marseilles.

EXAMPLES OF FRENCH DOCK SYSTEMS.

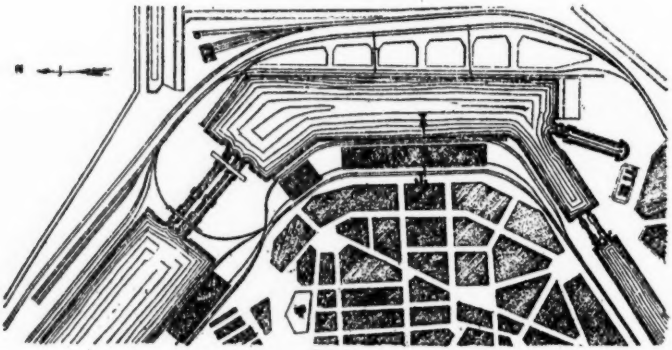


THE LOWER HARBOR OF GLASGOW.

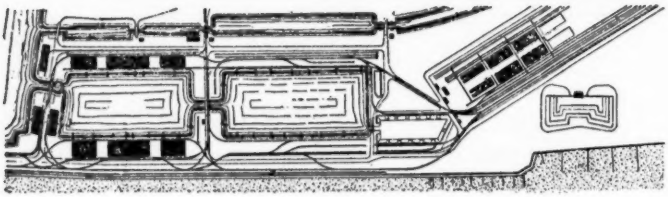
given is culled. One of the most striking illustrations of what has been done is that, whereas formerly there was so little water in the Clyde that merchandise had to be conveyed on pack-horses 29½ miles by land to its usual port, the Campania and the Lucania, each 620 feet long, by 65 feet 3 inches beam, by 43 feet deep, were launched within half a mile of the western boundary of Glasgow, and steamed through the artificial river to the sea.

It is interesting, in passing, to note that the improvement of the river Clyde began in 1566 with attempts to cut channels through sand banks, etc., but that "up to 1768 the entire length of river between Glasgow and the sea remained practically in a state of nature, with only about fifteen inches depth in places at low water and three feet eight inches at high water, choked up with sand banks, impeded by numerous fords, and only suitable for herring boats." By the year 1825, however, the river had been deepened to nine feet at high water, and authority was then granted to increase the depth to thirteen feet. But it was not until 1838 that comprehensive treatment of the river as a whole was begun. Now the depth of the river and harbor is from twenty-seven to twenty-nine feet at high-water neaps, spring tides being two feet higher. Steamers drawing 24½ feet now pass up and down the river. As the river navigation was improved, the harbor was extended, and, when the era of steam navigation arrived, other harbors began to be established all along the Clyde, such as Renfrew, Paisley, Bowling Harbor, Dumbarton, and Port Glasgow. The artificial Clyde extends down to Greenock. Within the Clyde district there are upwards of forty ship-building yards, some of which are several miles above Glasgow. Our map shows the part of the city where the commercial docks are situated and their respective locations and prominent features. The dock first constructed is called Kingston Dock; it has 5½ acres of water-space and about half a mile of quayage; the second is the Queen's Dock, with 33½ acres and nearly two miles of quayage; and the third is now constructing on the south side of the Clyde. The Queen's Dock comprises three basins; the inner basin is 1,866 feet long by 270 wide; then comes a quay 195 feet wide, serving both it and the middle basin, which is 1,647 feet long by 230 feet wide; the outer basin is 1,000 feet by 695 feet. The dock is tidal, and is approached by an entrance 100 feet wide, crossed by a swing bridge. The substructure of the quays is of triple groups of concrete cylinders, and the superstructure of concrete rubble faced with concrete ashlar and surmounted by a granite coping, the old wooden types having been abandoned.

The provisions made by the Clyde trustees in the way of com-



Calais.



Havre.

EXAMPLES OF FRENCH DOCK SYSTEMS.

mercial plant on the docks and quays was described in the previous paper.

The entire cost of the Clyde Navigation to date has been in the neighborhood of $70,000,000, and there has been returned a gross revenue of not far from $50,000,000, the annual revenue now amounting to nearly $2,000,000, or something less than three per cent. The surplus revenue, after meeting all expenses and fixed charges, is now about $200,000 (£40,000) annually.

The illustrations of French dock systems and quay sheds and the map of Hamburg harbor are reproduced from the Transactions of the American Society of Civil Engineers. The author desires also to express his acknowledgments to Mr. C. W. Hunt and the Brown Hoisting and Conveying Machine Co. for courteous assistance.

COST-KEEPING METHODS IN MACHINE-SHOP AND FOUNDRY.

By Henry Roland.

II.—DETAILS OF PRACTICE IN WIDELY-KNOWN SHOPS.

NO abstract statement, even though supported by the most cogent evidence and argument, can ever have the force of example. Therefore details of practice must be held more instructive than any comment or deduction based upon or drawn from the actuality, and in this view the close details, which here follow, of the means actually used in a number of important establishments to reduce labor-cost are of the utmost value.

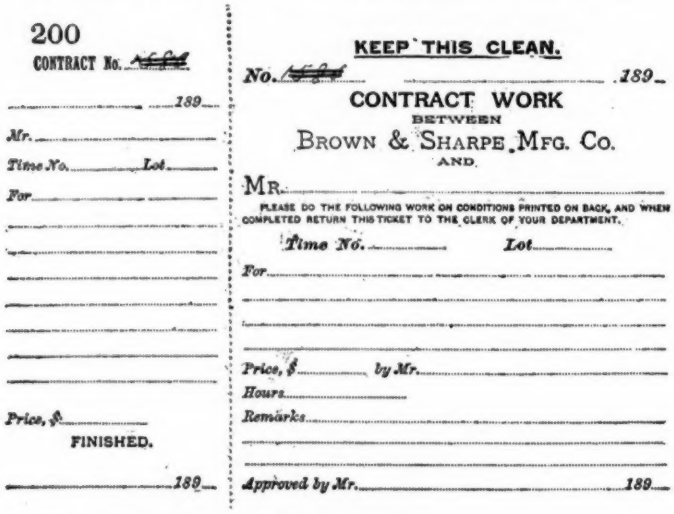
The Midvale, Sellers, and Baldwin establishments, of Philadelphia, Pa., and the Builders' Iron Foundry, of Providence, R. I., declare in favor of fixed piece-rates. Brown & Sharpe, of Providence, Yale & Towne, of Stamford, Conn., the Pond Machine Tool Works, of Plainfield, N.J., and many others believe in continued "adjustments," "adjustment" meaning reduction almost invariably. In the Baldwin shops piece-rates are not changed except in case of improved facilities which lower the time required for production, and the same is true at the Midvale and Sellers shops. There are piece-rates now in force at the Baldwin which have not been changed for twenty years. The Yale & Towne piece-rates are changed, or "revised," yearly, the revision of each department falling on a different date from that in any other department, revision almost invariably meaning reduction as before said; and this yearly reduction is accepted by the hands without resistance.

Before entering upon the details of individual shop practice, it may be said that inspection is rigid in all of the establishments here mentioned, although their high and, in many instances, world-wide reputation renders such a statement almost superfluous, and that the quality of work produced is of the highest grade in point of workmanship and reputation among purchasers and users.

In the Brown & Sharpe shops about two-thirds of the work is done at piece-rates. There is a great amount of special work done on individual orders which does not commonly fall under any established piece-rate, and is therefore put through at day-rates. Most of the moulders are paid at piece-rates, although a large amount of special work is constantly going through the foundry, much of which is paid for at day-rates. There is no contracting whatever in the Brown & Sharpe shops, nor can any workman in any way make a profit on the

labor of other workmen. The shop routine on piece-work is simple, except in the detail of fixing piece-rates, which is made a matter of consultation; sometimes the workman is called into the discussion.

It is the policy of the Brown & Sharpe establishment to trust in a multitude of counsellors, all experts, and all, strange as it may seem, open to conviction by the arguments or experience of others. But this extended and elaborate consideration of a piece-rate is not held to infallibly produce a correct result. Instances have been known in this shop where a workman voluntarily reduced a piece-rate, saying it was too high. Where a workman, after trial, thinks a piece-rate too low, the matter is fully considered once more, often with the result of increasing the rate. Sometimes, however, the increase is refused. When a piece-rate is fixed, the job goes to the workman with this blank, from a stub-book, and the workman may be any hand in the shops, from a boy at 4 cents per hour to the highest-priced mechanic.



200
CONTRACT No. ~~4 Cyl~~
....., 189..
Mr. .....
Time No. ..... Lot .....
For .....
.....
.....
.....
.....
.....
.....
.....
Price, $ .....
FINISHED.
....., 189..

KEEP THIS CLEAN.
No. ~~4 Cyl~~ ....., 189..
CONTRACT WORK
BETWEEN
BROWN & SHARPE MFG. CO.
AND
MR. .....
PLEASE DO THE FOLLOWING WORK ON CONDITIONS PRINTED ON BACK, AND WHEN COMPLETED RETURN THIS TICKET TO THE CLERK OF YOUR DEPARTMENT.
Time No. ..... Lot .....
For .....
.....
.....
.....
Price, $ ..... by Mr. .....
Hours .....
Remarks .....
.....
.....
Approved by Mr. ..... 189..

This contract bears on its back the words:

The person accepting this contract for piece-work agrees to complete the work specified to the satisfaction of the inspector, and for the amount named in the contract.

Only such work as passes inspection will be paid for, and the workman will be charged for lost labor on parts spoiled while he holds this contract, unless occurring from a cause for which he was not responsible.

This contract must be carefully preserved and returned with the foreman's signature and exact time recorded.

This contract is returned to the foreman with the finished work, and name and number of pieces and time and rate of workman's earnings are entered in a suitably-ruled book supplied to each foreman for the purpose. These record books are of the utmost value for reference, giving a brief history of all piece-work done in the shop.

Spoiled work is arbitrated, and, if the workman is clearly in fault, he stands the loss of his labor, the shop losing the stock: if the piece-worker spoils a second operation, he does not pay for the previous work.

A piece-rate may be increased before the first job is finished, either because the rate was fixed too low, or because of hard stock or unexpected difficulties in some of the operations.

There is no hard and fast rule in the Brown & Sharpe shops as to the hour-rate a piece-worker may earn before it is considered advisable to reduce the piece-rate. If the work is uniformly well done, a workman may hold a high rate for a long time. But the general rule is that, as the workman continues on one piece, his out-put increases, and, when it becomes certain in the minds of his superiors that his piece-rate can be lowered without impairing his ability to earn good wages, the adjustment is made, with a full exhibit of the situation to the workman, who is expected to, and almost invariably does, take a reasonable view of the matter, everything being done deliberately and under consultation. Here, it will be noticed, the implied condition of the "going day-rate" of workmen's wage becomes the real ground of the argument justifying the piece-price reduction. The workman is making much more than the "going rate" of his class,—that is to say, more than he is entitled to earn,—and has been making this unwarranted rate for a long time by grace of the employer in fixing a high piece-rate. He is offered a lower piece-rate, which will still enable him to make more than the going day-rate. If he refuses the cut, he is shown that he is acting against his own interest, and the ground is taken that he is ungrateful to a benefactor. How just these assumptions are, or how unjust, is a matter of no importance, as before stated. The workman can take his choice of two losses, and he is almost certain to choose the lesser of the two, and continue his piece-work at the reduced rate offered, as it gives him higher pay than he is likely to obtain otherwise, while the shop is perfectly justified in the reduction, which still leaves the pay higher than the workman can obtain elsewhere.

The Yale & Towne Manufacturing Company, Stamford, Conn., with its high pay-roll of 1,100 names, is too well known as a producer of high-class locks and builders' hardware to need extended notice here. The establishment is divided into a considerable num-

ber of departments, each having its own foreman and book-keeper; and, when the shop is full, about four-fifths of its work is done at piece-rates. In all cases slack work increases the percentage of day-rate work, because the jobs do not last as long and there is more special work in dull times. The tool-makers,—of whom there is a large force, as tool-making is carried to the extreme limits of economy in this shop,—pattern-makers, chasers, and modelers are all day-pay men, and all small jobs of special work are done at day-pay.

The Yale & Towne piece-rates are fixed much as in the Brown & Sharpe shops, under consultation with those supposed to be best informed, and, when a piece-rate is fixed, it is expected to remain in force for a year, except in case of new work, where the management assumes the possibility of error in rate-fixing, and reserves the right to make changes at any time during the first twelve months. Such changes may be in either direction—up or down. For fixing upon the yearly "adjustment" of old rates, the results of the previous twelve months are tabulated and compared with foregoing records; and the rate is discussed with the foreman of the department where it is to be used, and with experts in the line of work. The new rate thus established is sometimes greater than that for the year just passed, although, as a rule, the new rate is lower than the old one. Whatever the rate may be, it is commonly accepted without protest by the workmen. If protest is made, the workman is requested to make a trial under it, and the trial almost invariably establishes the correctness of the rate. Thus in one case a trial under protest resulted in a first day's work at a loss to the workman, the second day was about even, while the third gave a bonus above going day-rates to the piece-worker, who finally averaged twenty per cent. above his day-rate for the year's work. In some rare cases, however, the piece-rate is raised after a thorough trial. Resort is sometimes had in the Yale & Towne piece-rate fixing to actual trial, the work being given to an extremely good workman, whose trial output is assumed to be about twenty per cent. too low, as it is invariably exceeded by about that difference by the piece-worker operating under the piece-rate.

The shop routine of piece-work at the Yale & Towne begins with the receipt of the shipping order, which is first audited in the main office of the works, and, if satisfactory, then passes to the superintendent of the department producing the work demanded, who first audits the bill himself; if he finds it acceptable and in proper form, he returns it to the order clerks, who record it and fill it as far as possible from finished stores; if the order can be completely checked from items in stock, the goods are shipped the same day; if not, the

order goes back from the finished stores to the order clerks again, who proceed to fill out "requisitions" to departments for the lacking items; the order is then returned to the shipping-room, and held until filled. This shipping order is as follows:

STAMFORD.

REGULAR / CONTRACT } No.....

NAME.....

DATE.....189

ESTIMATE NO.....

Entered by General Order Clerk.

.....

RECEIVED IN DEPT..... .....

SHIPPED.....BY.....

CHARGED.....BY.....

The Yale & Towne Manufacturing Company.

Shipping Order.

TO .....

ADDRESS .....

.....

SHIP VIA.....

.....

WHEN WANTED: COMPLETE SHIPMENT.....

BUTTS.....LOCKS .....

HARDWARE.....

SHIPMENT PROMISED.....

DEPARTMENT

.....

DATE	CASE	WEIGHT
.....	.....	.....
.....	.....	.....
.....	.....	.....

DATE	PACKAGES	WEIGHT
.....	.....	.....

PHOTO WANTED	QUANTITY	LIST NUMBER	PRICE WANT'D	ORNAMENTATION AND ARTICLE	FINISH	PACKED BY

The department "requisitions" furnish the order to proceed with department operations. If rough stores are at hand, the finishing-time required is estimated, and the date of completion is given to the order clerks as the "due-date," or date on which the finished work will reach the shipping-room. If castings are wanted, the head foundryman makes a promise for delivery to the finishing department, or, if patterns must be made, the foreman of the pattern-makers promises the patterns at a certain date, the foundryman promises the castings, and the head of the department requisitioned adds his finishing-time, and thus fixes on the due-date and transmits the same to the order clerks, who forward the due-date to the customer. This due-date must be kept good, and is not to be regarded merely as a guess. The goods are expected to be in the shipping-room on the date named, and any failure causes conversation of an unpleasant nature to the foreman responsible. If any part of an order is to be filled from the outside, the first "requisitioned" foreman in turn issues a requisition on the purchasing agent, and the purchasing agent's advices may have to be awaited before deciding upon the due-date. The requisition from the order clerks to the department goes finally to the shipping-room with the finished work, and the requisition is filled in with all particulars of labor- and stock-cost, which are afterward collected in reference-books for future guidance.

While individual piece-rates are the rule in the Yale & Towne

shops, there are yet some contracts in force under which contractors employ workmen and can make money from the work of others, and it was said that in one large department, where the work has been reduced fifty per cent. in labor-cost under the individual piece-rate system, the old contractor, who is still an employee of the concern, offers to take the work on contract at ten per cent. below present rates, as methods and tools have been improved largely under his charge since his contract was abolished.

As in the Brown & Sharpe shops, so in the Yale & Towne the workmen are in direct communication with the management, although nominally under exclusive control of their foremen; all sources of dissatisfaction are carefully investigated, and every effort is made to reach impartial conclusions agreeable to all concerned, an amount of consideration being given to the feelings of the individual workman which would not be entertained for a moment in the ordinary large machine-shop operated on the day-pay system.

At the De La Val shops, Poughkeepsie, N. Y., all orders are received from the New York office, the shop being treated as a trusted employee of the New York office with a yearly settlement.

The shop routine for handling work begins with an order from the New York office order book, each leaf of which is printed in three sections, first a stub, retained in the book, then a perforated cross line and the original order filled at the New York office and manifolded on the reverse side of the third section of the leaf, there being a second cross-line of perforations in the order book page, so that the manifold order blank can be turned under the original order blank, permitting the insertion of a carbon paper between the two, and the filling of both orders at once, all as shown in the reproduction below:

(Stub retained in N. Y. Office Order Book.)	(Original Order made by N. Y. Office; a duplicate-carbon copy is sent to the Poughkeepsie shop.)
	(POUGHKEEPSIE WORKS.)
No.... 189	No..... NEW YORK,.....189
To be shipped	Ship.....
....	To.....
.....	.....
By.....	By..... Via.....
Via.....	.....
.....	.....
....	.....
Ordered by.....	Shipped
	.....

By use of this ingeniously-devised order book the New York office has a stub duplicate of each shop order transmitted, and the shop has an original office order and a manifold *fac-simile* duplicate, which it

compares with the original order and then returns to the main office, thus certifying the receipt of the order, while the manifold serves as a check on the stub in the New York office order book, so that no misunderstanding of orders between the office and shop is possible.

All material received from the outside goes to the rough stores, and is checked in and out by a system which gives instant information as to stores on hand, while a finished-stores room is placed between the machine-shop and the assembling department, all finished parts being checked in and out, as in the case of rough stores.

The De La Val separator, or milk-and-cream-separating machine, requires from 6,000 to 7,000 revolutions per minute of its effective member,—a spindle carrying a steel bowl,—and necessitates construction of the most accurate description. Much of the work is repairs, and repairs are all made at piece-rates, as was the original construction. The shop has been under three managers, and the present control is unfavorable to piece-work, believing that, with the same gages and same inspection, work assembles better when made at day-rates than when made at piece-rates.

A filled-out repair statement is here given, which will be of interest to those dealing with machine repairs on a factory scale.

(POUGHKEEPSIE WORKS.)

No. *557* {*4204* / *4214*} *503.* New York, *3/3/97.*

Ship.....

To *N. N. Winston,*
Smithfield, Henry Co., Ky.

By *Express* Via *Am. X.*

Repair Baby No. 2 Bowl No. 19,547—your reports 4204 and 4214.

1 No. 509 Bowl Spindle	*2.90*
6 " 600 " Rivets	*.10*
1 " 442 Top Bearing	*1.00*
4 " 507 Milk Tubes	*1.00*
1 " 506 Cream Screw	*.10*
1 " 510 Tubular Shaft	*1.50*
1 " 513 Bottom Disc	*.10*
1 " 512 Intm'd Disc	*.15*
Bowl Re-tinned	*1.00*
18¾ Hours at 40c	*7.50*
	15.45
Expressage in	*.65*
	16.10

Shipped by
March 16, 1897.
Bowl Re-balanced.

The foreman's report card is made in three parts,—the first belonging to the machine-shop, the second to the paint-shop, and the third to the inspector of finished stores,—and at once places the responsibility for faulty work where it belongs. The size of this card is eight inches by six.

REPORT CARD.

THE DE LA VAL SEPARATOR WORKS.

Shop Order.....

No. of Part..... ...

R. M. (Shop.)			(Paint Shop.) F. M.				(Inspector.) F. M.			(Finished Stores.)
Date.	Stock.	Rec'd by	Date.	Good.	Bad.	Rec'd by	Date.	Good.	Bad.	Rec'd by
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	....	.....	...	.....	.....	.....	.....	.....	.....

Work goes through the shop on an individual workman's card as below:

Shop Order No.....

THE DE LA VAL SEPARATOR WORKS.

No..... Mr.....

Piece No..... Name..... ...

Operation.....

Machine No..... ....

Time.	Hrs.	Min.
....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

Finished.

This card is white for new work, and pink for repair work. The information given by this card is condensed and tabulated for reference in the workman's pay receipt, which is made as given on the filled-out blank herewith.

DATE, *Mar. 29, 1897.* PART No. *501* ORDER No. *4*

WORKMAN'S NAME, *Samuel Melgaard.*

QUANTITY, *80*		RATE, *20*			*16.00*	
Week ending	HOURS.	*Per Hour* RATE.				
April 3.	*59*	*18*	*10*	*62*	....	...
....	.....	.....	....	....	....	....
....	.....	.....	...	....	....	....
BAL.	.....	.....	*5*	*38*	....	...
			16	*00*	*16*	*00*

REC'D PAYMENT, *Samuel Melgaard.*

The size of this card is six inches by seven and a quarter.

This receipt gives the important results of each piece-rate contract in the briefest terms, and is so filed as to permit instant access for two years, which is considered the limit of probable reference time.

In the De La Val shops piece-rates are subject to change without notice, and the workman is not guaranteed a minimum earning. The greater part of the workmen are employed at day-rates. Forty cents per hour is the highest piece-rate-earning permitted.

The methods of inspection do not insure against previous faulty operations on a piece, and there is no penalty for spoiled work, except loss of workman's time. Some of the hands prefer piece-work, some day-work. Twenty cents per hour is paid on piece-work time on regular pay day, should the piece-work run over it, and at the end of a piece-rate contract the workman receives the balance due him, as per card given.

At the Pond Machine Tool Works, Plainfield, N. J., piece-rates are fixed by the official charged with that duty, who may make the estimate unaided, or may, and very often does, advise with others who can give him information, including workmen. In some cases various workmen capable of executing a certain piece of work are asked for their own terms, and the work is given to the one most suitable for the job. There is no face-to-face competition or bidding. Prices are obtained from different workmen, and the award is made where it seems to the best interests of all concerned to place the contract. Some of the work in the foundry is done at piece-rates, by contract with an individual moulder, who may or may not employ others to help him. The foundry foreman is paid a salary, and cannot make anything above his pay. Piece-rates in both the foundry and

machine-shop are good for a single job only, and may be varied either way, up or down, for the same job at a subsequent date.

The work at the Pond shops is heavy; large lathes, large planers, boring mills, and radial drillers form the principal part of their machine-tool output, which is the regular work of the shop. Outside work taken in is also large. Heavy gun-carriages for the government and a lot of heavy rock-pulverizing machines were under way on the floor when the Pond shops were visited, and almost all of their work is heavier than that usually done at piece-rates. There is, however, no weight-limit for piece-work. Work at the Midvale Steel Works and at the Builders' Iron Foundry is also heavy, and the Midvale places everything at piece-rates, while the Builders' Iron Foundry intends to operate under piece-rates in all cases where the quantity of work makes it economical to do so. The Sellers Shops also build work of magnitude, and, although there is a generally-entertained idea that piece-rate methods cannot be successfully applied to finishing heavy work, there is no obvious ground for the belief. In the Midvale and Sellers shops piece-rates not fully determined by previous jobs are made by surface time calculations, and at the Midvale absolute confidence is felt in piece-rates thus determined; I believe the same is true at the Sellers shop. Work at the Pond shops, where as many as 900 hands have been on the pay-roll at one time, is about equally divided between piece-work and day-work. The more ambitious hands endeavor to obtain piece-work, as piece-rates secure the possibility of something more than the day-pay rate.

Two blank forms are used in the piece-work routine of the Pond shops: the first is a stock order on which stock is procured from the stock-room; this order authorizes the delivery of stock to the foreman of a department, who receipts for it, and the order goes from the stock-room to the office, where it is entered to proper accounts.

Form of Pond stock order. Size $7 \times 5\frac{1}{2}$ ins.

No. *8080oA.* Mr..... .....189....

St'k order No..... The stock herewith is for order No.....

Please receipt for same.

	No.	Wt. or Num.	Price.		
....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

Received on above date

.....

The Pond piece-rate contract has a time record printed on its back. The contract form reads as follows:

Face of contract, size 8½ × 5½.

Form 44.

OFFICE OF

THE POND MACHINE TOOL CO. Plainfield, N. J. 189

Piece-work No..... ... B..... No.....

for..... ....

Order or Lot No.	Piece No.	Name of Piece or Part.	Price.		Amount.	
.....	.....	.....	.....	....	.....	.....
....	.....	.....	....	....	.....	.....
.....	.....	.....	.....	....	.....	.....

The above work will be settled for when order is completed and signed by tbe nspector.

Price approved.....

Back of contract: size 8½ × 5½.

Piece-Work No..... B..... No.....

TIME RECORD. Rate, $.....

	Hrs.	Amount.			Hrs.	Amount.		Time on Poor Stock.		
.....	....	.....	....	.....	....	.....	....		Hrs.	Amount.
.....	....	.....	....	.....	....	.....	...	.....	....	....
.....	....	.....	....	.....	....	.....	....	.....	....	....
.....	....	.....	....	.....	....	.....	....	Time on Spoiled Work.		
.....	....	.....	...	.....	....	.....	....		Hrs.	Amount.
... .	....	.....	....	.....	....	.....	....	.....	....	....

This contract and time record are printed in duplicate on a perforated sheet, the duplicates going to the office.

The Pond system of handling piece-work is marked by entire freedom from the possibility of establishing what might prove to be embarrassing precedents, the motive being to deal with each individual job on new ground, so that the shop may have no hindrance in the use of knowledge acquired by experience.

Spoiled work entails the loss to the workman of his time only, the shop standing the cost of the material. Work on castings which

disclose defects in the course of finishing is paid for at day-rates, the shop losing both the casting and time put on in partial finishing.

At the Baldwin shops, Philadelphia, where as many as 4,000 names have been on the pay-roll at one time, a rate once fixed is permanent, and all of the men, without exception, prefer the piece-rate, being fully convinced that piece-work is better for themselves and better for the shop, and consequently far more satisfactory both ways than the day-rate. A visitor at the Baldwin shops who is familiar with machine-shop interiors is made immediately conscious of the close attention the hands are giving to their work, and, as he becomes acquainted with the various departments of that large establishment, he finds that all the workmen in the place are as eagerly expediting their labors as the first which met his eye. The cause of this diligence and voluntary exertion becomes clear when the observer learns that the man who makes the highest pay is held in highest esteem by the management, and hence has every inducement to turn out all the work he possibly can. By so doing he not only adds to his pay, but ensures the continuance of his large winning, since he increases his good standing by his large production. In addition to this certainty of rates, the Baldwin workman is sure of employment so long as he does not forfeit his good standing by some fault of his own, his long time of good service ensuring his retention when age begins to diminish his powers. The only men discharged are those who cannot be made to bring their pay high enough to meet the views of the management, high pay at fixed piece-rates meaning, of course, the high production rate which the whole policy of the Baldwin shops is designed to secure. The results of this policy can be clearly placed before the reader by the simple statement that the Baldwin establishment is the largest single producer of locomotives in the world, and pays its men higher wages than are paid for similar employment elsewhere.

The establishment of Wm. Sellers & Co., Philadelphia, is one of the most widely known of American machine-shops, and has been a conspicuous factor in the advancement of American machine-shop practice. The high pay-roll for all branches of the business includes about 1,100 names.

Work at these shops is mainly at piece-rates, which are fixed in the office exclusively, either by reference to previous jobs or by surface computation, and, when once established, are not changed.

Spoiled work is arbitrated, but the regulations are directed against carelessness on the part of the workman, who is required to examine all work done on a job before it comes into his hands for a subsequent operation, and to report any imperfection to his foreman. Failing to

report previous errors in a piece of work, the last workman loses all the work on a faulty piece, no matter by whom performed.

The shop routine of piece-work begins with the shop order, which is made up so as to finally include a complete history of the job, except labor-costs and time. The face of the shop order is as below.

Form 1, 8020-11-94-C

..... 189 *No. of Order* .....

Order Book Folio ..... *Charge* .....

For .....

Delivered ..... 189 .....

Sig. *Receiving and Delivering Clerk.* *WEIGHTS.*

Boxing Lumber *feet,* *Hauling* *loads to* *Expense*

Charged 189

Sales Book Folio ..... *Sales Clerk Sig.* ..... *WM. SELLERS & CO., Incorporated,*

Cost Book Folio ..... *Cost Clerk Sig.* ..... *Per* .....

The back of this order carries a synopsis blank, as follows.

O ***Received by Foreman.***

O ***Finished*** ***189*** ***Gang Foreman.***

O ***Received by Receiving and Shipping Clerk.***

O " " ***Sales*** "

O " " ***Order*** "

O " " ***Cost*** "

Inspected ..... ***189*** ..... ***Clerk.***

The piece-work ticket, or contract with workmen, is 4 × 3 inches in size, and reads as follows on the face:

Book..... Page.....

Ticket No..... Register No..... Order No. .....

To..... Card No.....

Charge..... Group No. .....

... . Job..... Cut... ....

.....

.....

Price.....Time.....Shop No. of Machine.....

Upon the conditions on the other side.

.....Foreman.

The reverse is printed as below:

Conditioned, that in accepting this contract the contractor guarantees to complete the same to the entire satisfaction of the foreman with whom he contracts, and, if he expends any labor upon raw materials, or upon materials partially completed by other parties, which are defective in workmanship or materials, he shall not be paid for the same, unless the defects are pointed out by him and accepted by the foreman in writing.

Return this ticket to your foreman every day on which you charge time to it.

DATE.	TIME		DATE.	TIME.	
	on this Job	Total this day.		on this Job	Total this day.
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

Accepted by.....
Foreman.

The position of the Sellers Management is clearly defined as favoring piece-work wherever it can be used, and against the changing of piece-rates once established, except in case of the employment of improved means of production.

It will be observed that the system of managing labor at the Sellers establishment is extremely simple, and that the order blank and work ticket are made in such form that, when filled out, they together contain the entire history of the job to which they relate, ready for transfer to the permanent books, thus saving clerical labor, while the permanence of piece-rates relieves the rate-fixing department of an interminable task in the way of watching the piece-rate totals paid to each workman, with a view to "adjusting" such totals to lower figures at the earliest possible moment.

THE AMERICAN TALL BUILDING FROM A EUROPEAN POINT OF VIEW.

By S. Henbest Capper.

IN the "country of wonderful" (and, be it confessed, even wearisome) "distances," *tallness*, of one sort or another, is an ideal pronouncedly sought after, sometimes even held to be, like virtue, its own reward.

Of this the great tower and pinnacle of the city hall at Philadelphia are an unhappy instance. Ill-designed and crowned with a scarcely appropriate statue that is much too big,—it is said to be seventeen feet high,—this huge architectural failure has little to recommend it but its exaggerated height, which is claimed "to beat the European record." Could any ambition be more futile? Had its builders set themselves to raise a tower more beautiful than anything in Europe, and had they thus "beaten the European record," how grateful would all the world (including Europe) have been to them! And those old towers themselves, of Europe, still after so many centuries the joy of their beholders, would have borne proudly the knowledge of a younger sister more beauteous then they. But at Philadelphia success means to have distorted a design. This

THE NEW CITY HALL, PHILADELPHIA, PA.

THE CITY AND CATHEDRAL OF COLOGNE.

wondrous fallacy of beating some one else's record—borrowed, presumably from that huckstering spirit which has turned the god-like athlete of a Myron into the modern professional of the race-track and the ring—has certainly no place in architecture or in any art. It must, without fail, reduce art to vulgarity.

Take another signal instance,—the great memorial obelisk at Washington,—and compare it with its prototype. The guide-books tell us that it contains so many thousand blocks of stone, and again that it "beats the European record" by being 555 feet high. What is this obelisk after all? A huge stone casing to an elevator, aping the form of an Egyptian monolith. The obelisk, as reared on the banks of the Nile four thousand years ago, was the most stately, most

THE TOWN OF BURGOS, SPAIN, AND ITS CATHEDRAL.

appropriate form for a high memorial block of stone ever devised; and these old obelisks, graved with their brilliantly-decorative hieroglyphics, are still unrivalled. The ancient Egyptians vied eagerly in the size of these noble blocks; the largest weigh several hundred tons; those erected at Karnak by Hat-shep-sut have a fine and most interesting inscription, recording the pride of their founder in the speed and success with which her design had been carried out, and, above all, in the grandeur of scale of these obelisks she had achieved in honor of Amen. But no Egyptian ever dreamed of *building* a piecemeal obelisk to "break the record." A monolith built of little pieces is a *reductio ad absurdum*, if not a fraud, and was reserved for the glorifiers of that distinguished American who "could not tell a lie."

"Tallness," therefore, as an ideal, is not necessarily right in art;

it by no means leads infallibly to artistic success. Height, when achieved with due proportion, is undoubtedly a noble quality in art, appealing deeply to the imagination; but mere "tallness" may be as far as possible removed from well-proportioned height.

Another point, too, may be briefly noted. In matters of taste, familiarity is often an essential factor; in architecture especially, which is, above all, the art of common sense and sobriety, to shock is not to carry ultimate conviction, and any violent departure from accepted standards must emphatically justify itself. Bewilderment is not akin to admiration, nor does gaping wonder tend to intellectual assent.

PANORAMA OF THE TOWN OF STRASBURG.

Probably to most of those who are sufficiently interested in architecture to take heed of contemporary work the "tall buildings" of New York and other cities embody America's chief contribution to modern architectural advance. They have led to new and complicated problems of construction, solved doubtless with all the energy, the boldness, and the address characteristic of American engineering. They also present esthetic problems of considerable importance and interest, the solution of which is perhaps not so apparently ready or

convincing. At any rate, in New York itself, where these "tall buildings" are already fairly numerous, the divergence of design, not merely of ornamental detail, but of radical conception as a whole, is very marked. All is tentative, and all (one might almost add) attempted, for much is extravagant, tried (it seems) if haply the result may justify the trial with a success which aims at rather the clamour of advertisement than the excellence of studied and achieved design.

The problem asking for solution is an eminently modern one. Architecture cannot, on pain of proving untrue to her traditions as a living art, refuse to entertain it, to grapple with it, and eventually to reach a satisfactory solution. We must, I hold, put definitely aside the criticism so often heard: "These tall monstrosities are not architecture at all; they are only engineering, with a stone veneer." They are buildings of our modern city streets; and, if these be not architecture, where indeed *is* modern architecture to find her place? She is bound to find her own solutions for novel problems, however difficult, and to achieve a harmony between the requirements of to-day and the accepted canons of artistic sense. It is essentially in responding to the needs of modern complex life, in interpreting and meeting them, that the art itself is modern and living.

The problem is undoubtedly difficult. As usual, it reaches the architect in a somewhat advanced and complicated stage; he has to grapple with it with many data already definitely fixed and binding his design. On a restricted site of enormous initial cost, a building has to be erected of sufficient cubic capacity to "pay."

The financial problem dictates extension by way of height, which, however, creates at once constructive difficulties. These are being met and satisfactorily disposed of by the many expert engineers who have so brilliantly worked out the various novel methods embodied in the construction of these "tall buildings"; several interesting papers in regard to these have recently appeared in THE ENGINEERING MAGAZINE. New methods of foundation have been evolved, apart from which the main factor in construction is the steel-skeleton structure. The requirements of floor-space (dictated by financial needs) rigidly limit the supporting and enclosing walls to the least superficial area compatible with safety and stability. Further, the need for the maximum of light in the interior equally leads to the reduction of wall thickness and external piers, while it forces the engineer to find a substitute for the ordinary diagonal bracing and cross-ties, which are incompatible with windows. With these complicated restrictions, the architect has to design his building, fettered and hampered, or, on the other hand, inspired, it may be,—for restriction is ever a fertile cause of happy ingenuity and an occasion for success. Moreover, be it re-

membered, the architect has here artistic opportunity in height before undreamed of, and quite beyond his reach without the steel-framed structure, which is here the essence of his building.

In the first place, the buildings have the very great advantage of being isolated above street-level. They can, therefore, be designed as complete in themselves, in a way that no ordinary street building permits. But they are seen all round, and must be designed as a building in three dimensions, not as a mere street front. In spite of this self-evident fact, some glaring instances to the contrary are in painful evidence. The St. Paul Building in Broadway at present is so indescribably maimed in this respect that it can, presumably, be but partially complete. As it stands, a more striking instance hardly could be found of designing a front without looking round the corner, in this case the neglected "round the corner" being considerably more in evidence than the columned stories of the front itself. But any possible design would have been irretrievably ruined by the utter hopelessness of this site in shape and superficial area.

This isolation is, of course, a permanent advantage, for the buildings, to achieve their object, must remain isolated and apart; if crowded up, their lower storeys become correspondingly reduced in value. It is said that this is an economic factor that has already made itself felt; and it is quite conceivable that in self-defence the "tall buildings" will surround themselves with shorter neighbours, or, in other words, will come to be designed as only the central portions of a larger, lower block. If so, their design will be a good deal modified, probably in marked improvement. At present the lower storeys are said to be in little demand, and, as the streets, which are darkened by these buildings, are generally too narrow, it is possible that an expedient may be found corresponding somewhat to the arcaded streets of old Bologna, some portion of the ground space being given in compensation to the darkened streets, to the no small gain of the jostled foot-passenger. This would not necessarily cause the buildings to appear propped up on stilts; it would be more likely to add to the importance of the lowest storey by the pillared complexity introduced.

In the second place, where so great height is *de facto* attained, it seems unnecessary to emphasize it in exterior design. A good many of the buildings are designed on the principle of strongly vertical lines carried through many storeys. This I venture to think a mistake. It is right for a comparatively slender tower, undoubtedly, where the sole object is height; every one will recall the noble campanile of St. Mark's at Venice (in the lower and comparatively early portion), as well as many others. These "tall buildings," however, in spite of their tallness, are by no means towers; they are spacious

TWO DOMINATING BUILDINGS ON DIFFERENT REACHES OF THE THAMES—THE NEW HOUSES OF PARLIAMENT, LONDON, AND WINDSOR CASTLE.

and habitable buildings; to design them as towers is a twofold mistake, both practical and esthetic; it is their openness, their brilliant lighting, their spaciousness, that should be emphasized, and that can best be done by horizontal treatment of the storeys. Moreover, such a treatment would be, perhaps, more in accord with their construction. It is one of the misfortunes of their steel-skeleton construction that it must all be, perforce, concealed. The material, unless buried in a fire and weather-resisting shell, is extremely ephemeral and unenduring. Consequently, the architect lacks that guidance of dominant construction which goes so far to make a design coherent, logical, and easy to interpret. Yet it is a fact that these great buildings are erected in horizontal stages, comprising, it may be, several storeys each, but still well defined platforms, or stages. And these should surely be seized upon, if practicable, and interpreted in the exterior design. It seems to me that in this way the buildings would very greatly gain in meaning and expression. A word or two may here be suggested in regard to this construction from the esthetic point of view. Since the Gothic revival, with its battle-cry of "ornamented construction" and its decry of "constructed ornament," it is natural and inevitable, and surely right, to seize first on genuine construction to be interpreted and expressed in a design. Where, then, is there room for this totally-concealed construction? Some would, of course, deny *in toto* its right architecturally to exist; metal cased in stone, they claim, is a quite illegitimate method of architectural construction, being a sham of the most flagrant kind. To deny, however, to iron and steel the position they have conquered in the world of modern construction is, of course, wholly futile. But from their perishable nature they must be hidden away for their own protection. How, then, are they to be dealt with? The most obvious method is to case the metal in some form of plastic material, such as terra-cotta; steel construction, thus treated, is quite capable of honesty above reproach. Whether stone is a wholly legitimate substitute for a plastic material thus required to case it in is a good deal more open to question. It is certainly more costly, and more difficult to handle; above, all it is a less natural material, when so used. We are all so thoroughly accustomed to stone, "solid stone," as a material for the most durable, the most massive, and the most solidly constructed buildings, that it is certainly a shock to see it cramped on to a steel backing, treated like a veneer, pared down, and pinned and bolted into place. This is certainly not material used in its natural way; it is so unnatural, and shocks so irretrievably, that I very much doubt if it can be accepted esthetically as so satisfactory as a wholly plastic material.

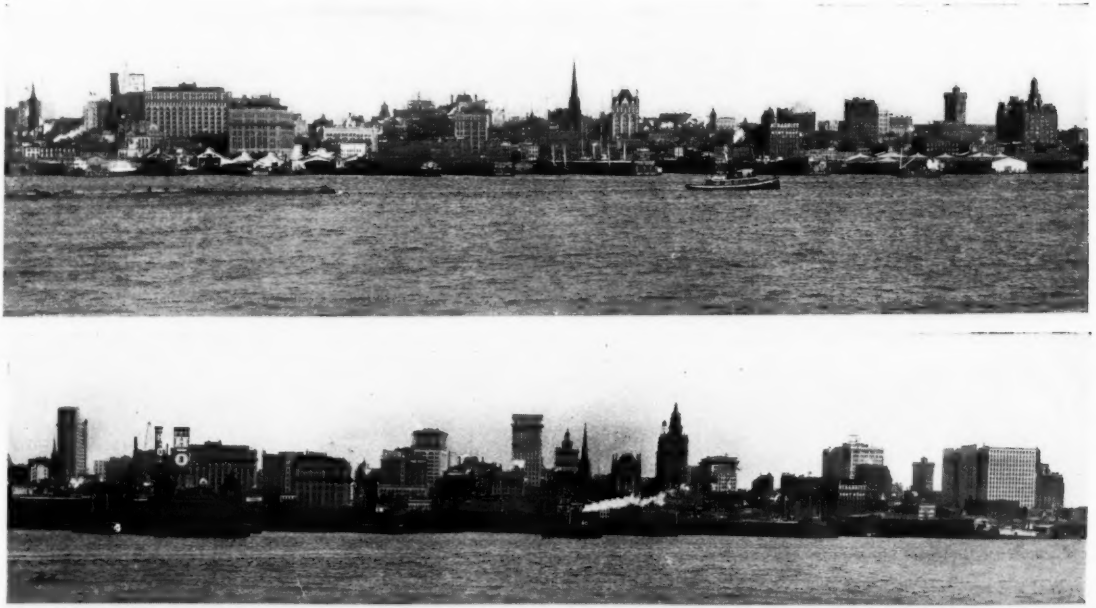
On the other hand, it may be legitimately contended that with stone one can get both colour and texture, which are not to be had in any terra cotta or similar material. These are the two sides of a controversy incapable, it seems to me, of dogmatic decision; but I return to the craving at least for horizontal lines in the masonry as opposed to vertical, more especially if these can be made to interpret something of the method of construction in horizontal stages.

In the third place, much and lavish exterior ornament seems wholly out of place. The buildings are themselves so large and so imposing that they do not require enrichment to give them interest; mere surface ornament becomes unmeaning and superfluous; when used on so large a building, it becomes mere frittered labour, painful

THE COLOSSEUM AT ROME.

from its ineffectiveness. Many of the "tall buildings" of New York are rather lavishly ornamented, but the ornamentation is ultimately felt to detract from, not to enhance, their size. The truth is that, in a very large building, an almost monotonous repetition is of potent artistic value. Of this the Flavian Amphitheatre at Rome, the so-called Colosseum, is a well-known instance. The steady repetition of the same architectural motive, in an apparently endless series of arcades with engaged columns between, impresses the beholder with an irresistible majesty. Something of the same effect seems attainable in these tall buildings, with their monotonous repetition of similar window openings. And any ornamentation disturbs the resulting impression of

solidity and power and scale. It is noteworthy that the "tall buildings" of old Edinburgh, somewhat famous in their way, are totally devoid of architectural ornament, though singularly effective in the fair city architecture of the "Modern Athens." The most recent type of the "tall building" in New York seems to relegate the ornamentation to the base storeys just above the street and to the top, or crowning, storeys. As has been mentioned, the lower storeys are said to be of inferior letting value, and are not, therefore, very naturally selected for extra cost in execution. But probably the temptation to enrich the storeys within fair reach of the eye from the street-level is strong, and artistically is defensible. Above all, the main entrance naturally calls for emphasis and enrichment; one does not expect to enter so imposing a building by any mean or insignificant doorway. The cornice is a great difficulty; it has not, it seems to me, as yet been adequately studied out. In so huge a block of building, it should have a projection unattainable in practice. In Florence the Strozzi Palace (though only a portion of the grand cornice has ever been completed) is a very fine example of a simple cliff-like façade crowned by a rich and noble cornice. In Rome one turns naturally to the grand cornice of the Farnese Palace, in competition for which Michael Angelo waxed so mightily indignant. Both these are classical examples, to which might be added, in more recent times, the Arc de Triomphe at Paris. But beyond this limit it is not possible to go in stone. What, then, are the designers of those "tall buildings" to do? The course generally adopted has been to use metal in place of stone; but the result is necessarily either fraudulent, in so far as the change from stone to metal remains undetected, or hybrid, as a patchwork of materials; neither alternative is satisfactory. I venture to suggest that it is preferable to abandon the attempt (which must be futile) to obtain exaggerated overhang, and to substitute therefor vertical depth; by restudying the cornice in this sense, including a storey or more in the depth of the cornice and its members, I believe a more satisfactory and a wholly legitimate result would be obtained. For this, too, we have an eminently successful classical example. The famous cornice of Vignola, with its deep consoles, will be readily recalled. Vignola, on a small scale, had the same problem to solve, and he solved it most judiciously by increasing his cornice in vertical depth without exaggerating the overhang. Modifications of this cornice are constantly used in modern French street architecture with happy effect; and, if a leaf were taken from the old Italian's book, though not without much study, there could doubtless be evolved a more suitable cornice for a "tall building" than by flying to metal and treating us to gilded gingerbread and tinsel two hundred and fifty feet above our heads.



LOWER NEW YORK, AS SEEN FROM THE HUDSON RIVER. THE UPPER VIEW WAS TAKEN ABOUT 1891, WHILE TRINITY CHURCH SPIRE WAS STILL THE CULMINATING POINT OF THE SKY LINE. THE LOWER VIEW WAS TAKEN IN THE SPRING OF 1897, AND SHOWS THE CHURCH ENGULFED IN THE SURROUNDING HIGH BUILDINGS.

It remains to add a word in regard to the effect of these "tall buildings" upon the appearance of the city as a whole. So long as they were few in number, they are said to have given New York a very ragged sky-line, unkempt, so to speak, and unpleasing. Now that they are fairly numerous, this seems no longer the case. The general raising of height—a result of modern city development by no means confined to New York—has necessarily tended to submerge many a worthy building that formerly rose tall and stately above its surroundings. An extreme case is Trinity Church, New York, a very sober and quiet study in perpendicular Gothic, the graceful spire of

THE MADELEINE, PARIS, SEEN FROM THE RUE ROYALE.

which formerly rose clear, a notable landmark of the city. It is now completely submerged and lost, rising, as it were, in slender effort, stifled in a sort of well. But this is painfully true of other cities, too. All visitors to Paris know how the Church of the Madeleine is now felt to be too low for its surroundings; how much it would gain by being raised above the houses that hem it in! In London also many of Wren's fine steeples are now almost equally engulfed and lost.

Nothing can excel the noble approach to New York; it is undoubtedly one of the fine harbours of the world. But the city itself is totally destitute of "heights." This lack the modern "tall buildings" certainly go some way effectively to make good, and I cannot but feel

ST. PAUL'S, LONDON.

FLORENCE. THE CATHEDRAL AS SEEN FROM THE CUPOLA OF SAN LORENZO.

sure that in sky-line and general appearance from the harbour New York has gained from them.

That such would be the case elsewhere is not so certain; New York, from its original flatness, is perhaps a special case. It is comparatively easy to dwarf nature; and one of these tall buildings, judiciously planted so as to spoil a natural landmark, could achieve without difficulty the total and fatal ruination of a noble scene. It is dreadful, for instance, to imagine the Acropolis of Athens girt around with buildings like those in Broadway. Imagine Siena, her valleys enriched with "tall buildings" sprouting high above that fair Duomo which so nobly crowns her highest rock! Imagine Florence, nestling by the Arno under the heights of Fiesole and the distant girding Apennines,—imagine Florence, now so fair, sleeping under Giotto's campanile and Brunelleschi's dome, were she to awake and find her Duomo dwarfed and thrown into the shade by a ring of New York tall buildings of the latest type, or of Chicago sky-scrapers!

Wren's noble dome, though somewhat dwarfed in height by its modern surroundings, nevertheless still floats in fair serenity, majestically crowning murky London. I cannot think that "tall buildings" are architecturally wanted in any of these cities; sufficient unto America be the "tall buildings" thereof.

THE ENORMOUS POSSIBILITIES OF RAPID ELECTRIC TRAVEL.

By Charles Henry Davis and F. Stuart Williamson.

II.

IN THE ENGINEERING MAGAZINE for October we outlined the engineering problems which must be solved to enable trains to be run at a speed of 170 miles or more per hour, discussing a specific case,—namely, a road on which trains should run from Philadelphia to New York harbor (a distance of 85 miles), without stops, in 36 minutes. It is the purpose of this paper to discuss the cost or the probable return from the investment. The assumptions (in addition to those in the first paper) have been made a basis for our figures:

(*a*) That the heaviest trains consist of five cars and can be safely stopped within 11,223 feet, when running at their maximum speed of 170 miles per hour; (*b*) that subsections (see signal diagram plate No. 3, first paper) would therefore be 11,223 feet long, and section signal towers 44,892 feet (8.5 miles) apart; (*c*) that central power stations are located at section signal towers and at each end of the line, eleven in all, and that rotary transformer sub-stations are located at sub-section signal towers, thirty in all; (*d*) that there are three tracks, the middle one being used for trains from Philadelphia to New York in the morning hours and for trains from New York to Philadelphia in the evening hours, and as an emergency track; (*e*) that a three-minute headway on each track could be maintained without danger, the trains being 8.5 miles apart and capable of being stopped within 11,223 feet; (*f*) that trains could, therefore, leave terminals every minute and a half during hours of heaviest traffic; (*g*) that, therefore, sixty trains would perform the service, or, allowing the necessary margin for delays, repairs, and waits, eighty trains (400 cars) would properly equip the road; (*h*) that each terminal has ten tracks, allowing a minimum of fifteen minutes for examination and shifting of each train before returning it; (*i*) that each terminal has room for eighty trains, not including tracks on lifts; (*j*) that the right of way is one hundred feet wide; (*k*) that tunnel excavations amount to 3,750,000 cubic yards, and cuts to 3,000,000 cubic yards, and that there are fills to balance cuts and tunnels; (*l*) that 10,000 volts of three-phase current is used on transmission lines, and 1,000 volts of direct current on feeder systems; (*m*) that each train will require not more than 10,000 i. h. p. at the station under economical conditions, the maxi-

mum capacity being about fifty per cent. greater; (*n*) that each station has an economical capacity of 30,000 i. h. p., with a maximum fifty per cent. greater, and each sub station an economical rating of 20,000 i. h. p. and a maximum fifty per cent. greater.

FIRST COST:

(*a*) RIGHT OF WAY AND REAL ESTATE:

1. New York terminal,	720,000 sq. ft. av. $20.00,	$14,400,000	£2,880,000
2. " " r. of w.,	300,000 " " " 10.00,	3,000,000	600,000
3. Elizabeth r. of w.,	528,000 " " " 1.00,	528,000	105,600
4. Woodbridge r. of w.,	528,000 " " " .50,	264,000	52,800
5. Trenton " "	792,000 " " " 1.50,	1,188,000	237,600
6. Phila. " "	1,584,000 " " " 2.00,	3,168,000	633,600
7. " terminal,	750,000 " " " 5.00,	3,750,000	750,000
8. Balance of r. of w., 800 acres at $1000,		800,000	160,000
9. Power house and sub-station real estate,		440,000	88.000
Total,		$27,538,000	£5,507,600

(*b*) CONSTRUCTION:

1. Engineering, 2% on $150,000,000	$3,000,000	£ 600,000
2. Clearing, 200 acres at $100	20,000	4,000
3. Grading, ditching, etc., to sub-grade 2,000,000 yds. rock at $1.00, 500,000 yds. hard pan at 60 cents, 500,000 yds. earth at 35 cents	2,475,000	495,000
4. Tunnels, 3 tubes including vertical shafts, each 59,136 feet long at $200 per foot each	35,482,000	7,096,400
5. Masonry, culverts, bridges, viaduct, as per profile complete, ready for rails	13,675,000	2,735,000
6. Fencing and 60 road crossings	1,300,000	260,000
7. Ballasting 20 cu. yds. broken stone at $1.00 and 7.5 cu. yds. of concrete at $3.00 per foot of line for 264,000 feet	11,220,000	2,244,000
8. Ties, steel 1000 lbs. per ft. of line, 448,800 feet at $15 per ton	3,366,000	673,200
9. Rails and fastenings 300 lbs. per yd. at $20 per ton of rail delivered	2,693,000	538,600
10. Track laying, lining and surfacing, and placing on viaducts 255 miles of single track at av. $3,000	765,000	153,000
11. Rail bonding 44,880 joints at $20	898,000	179,600
12. Third rail and supports, 3–300 lb. steel rails 74,800 steel supports at $10	2,094,000	418,800
13. Signals at $20,000 per mile	1,700,000	340,000
14. Telegraph at $5,000 per mile	425,000	85,000
15. Stations and buildings (except terminals) 11 power stations at $70,000, and 30 sub-stations at $10,000	1,070,000	214,000
16. Terminals, each 72,000,000 cu. ft. at 10 cents	14,400,000	2,880,000
Total	$94,583,000	£18,916,600

(*c*) EQUIPMENT:		
1. Locomotives and tender (none)	.....	.....
2. Motor cars 400 at $20,000, equipped with not more than 2,000 h. p. each	$8,000,000	£1,600,000
3. Passenger cars (included under No. 2)	.....	.....
4. Freight cars (none)	.....	.....
5. Electric feeder lines and ground returns (rails with bonding form sufficient return), feeders 14,400,000 lbs. at 15 cents in place, transmission line 7,040,000 lbs. at 15 cents in place, pole line, 8,976, with material and concrete at $50 each in place	3,665,000	733,000
6. Central power stations and sub-stations, 11 c. p. s. of 30,000 h. p. each at $40 and 30 s.-s. of 20,000 h. p. each at $5 each	16,200,000	3,240,000
Total	$27,865,000	£5,573,000
(*d*) GENERAL:		
1. Discount on $100,000,000 3% 100-year bonds	$5,000,000	£1,000,000
2. Interest on bonds to opening of road, say, 10 years of construction averaging 10 millions per year at 3%	16,500,000	3,300,000
3. Taxes to opening of road, assuming ¼ assessment and 2% rate	5,500,000	1,100,000
4. Office expenses, salaries, etc., to opening of road 2% on 150 million	3,000,000	600,000
5. Contingent, etc., not itemized, to opening of road 5 6%	10,014,000	2,002,800
Total	$40,014,000	£8,002,800
SUMMARY:		
(*a*) Right of way and real estate	$ 27,538,000	£ 5,507,600
(*b*) Construction	94,583,000	18,916,600
(*c*) Equipment	27,865,000	5,573,000
(*d*) General	40,014,000	8,002,800
Grand total ($745,098 per mile of single track)	$190,000,000	£38,000,000

The proposed line has not been surveyed, and our plan and profile (maps No. 1 and No. 2, first paper) were prepared from United States government and State maps, the scale not exceeding one inch to the mile. Were a careful survey made, additional curves and heavier grades could undoubtedly be used, tending to greatly reduce the estimated cost given herein. These improvements would probably balance those items which almost invariably cause the final cost of a line to exceed the estimated cost. In every case liberal figures have been used, so that the writers feel confident that an over-estimate has been made.

One might be inclined to think a cost of $190,000,000 excessive, were it not for the favorable comparison which can be made with the proposed rapid transit road for New York city at an estimated cost of $50,000,000 for less than 50 miles of single track (probably the cost of this road will be far greater than $50,000,000), or with the investments of the Pennsylvania and the Reading Railroad Company's lines between the two cities here considered. The United Railroads of New Jersey are assessed in New Jersey at about $50,000,000, the Central Railroad of New Jersey at about $35,000,000, and the Philadelphia & Reading Railroad at about $5,000,000. The figures in each case are approximate, and for that portion of the lines operated between New York and Philadelphia, not including other portions of the systems. Assessments in New Jersey are usually from twenty to forty per cent. of the actual value of the properties; assuming the higher figure, and allowing one-half additional for the value of the lines from the Delaware river to Philadelphia, with the same average assessment, we find:

Pennsylvania R. R., New York to Phila., value $187,500,000, £37,500,000.

P. & R. R. R. and C. R. R. of N. J., New York to Phila., value $150,000,000, £30,000,000.

Probably these figures are too low.

The proposed car would seat 140, so that a train of five cars would carry 700 passengers, seated; the maximum capacity in seated passengers would, therefore, be 28,000 per hour, or 466 per minute. Assuming the following percentage of travel, which closely conforms to experience on several suburban, elevated, and inter-urban lines, we have:

28,000	pass.	per	hour	for	2	hours	=maximum=	56,000 pass.
5,600	"	"	"	"	2	"	=20% of	maximum=11,200 pass.
2,800	"	"	"	"	7	"	=10% "	=19,600 "
840	"	"	"	"	8	"	= 3% "	= 6,720 "
					19	"	total pass. one way=	93,520 "
							total pass. both ways=	187,040

Making allowances for excursion loads, standing passengers, and empty seats during light hours, and assuming the above average maximum, the road should carry, in round numbers, 200,000 passengers per day, or 73,000,000 passengers per annum; the United Railroads of New Jersey carry to-day about 18,000,000 passengers, the Central Railroad of New Jersey about 12,000,000, and the Philadelphia & Reading about 17,000,000, or a total of 47,000,000. This, however, includes all passengers, whether local, commuters, or otherwise. The records do not show the totals between the points under discussion. These figures are of no special importance, for the laws which will govern travel on the proposed road do not apply to existing roads between these points.

The schedule, headway, car mileage, etc., necessary to the carriage of this number of passengers, are shown in the following table:

Leaving Headway Min.	Track Headway Min.	No. of Cars to each train.	No. of Trains per Hour.	No. of Cars per Hour.	No. of Hours.	Total Cars Run.	Car Miles.
1-1½	3	5	40	200	2	400	34,000
6	12	4	10	40	2	80	6,800
6	6	2	10	20	7	140	11,900
6	6	1	10	10	8	80	6,800
				(One way)		700	59,500

A daily total of 119,000 car-miles gives a yearly total of 43,435,000 car-miles, or 1.68 passengers per car-mile; as there are 500 trains per day, or 182,500 per year, we have 15,512,500 train-miles per annum, 4.70 passengers per train-mile, and 6,205,000,000 passengers carried one mile. Our trains average 2.8 cars each.

Below we give a table showing a fair distribution of operating expenses per train-mile by percentages of the whole (column No. 1), as obtained under ordinary steam-railway conditions. Column No. 2 gives the estimated reductions or additions for the proposed system, due either to the actual savings which should be realized on account of heavier and more substantial construction, or to the elimination of certain items by the changed conditions. These figures are based upon the probability that the cost per car-mile will closely approximate present practice, for, while fuel account and some other items will no doubt be increased, they are insignificant in comparison with the large saving in labor account, owing to the high speeds maintained and omission of local stations.

		Col. No. 1.	Col. No. 2.
(*a*)	Maintenance and renewal of way and works.		
	1. Repairs of earthwork to sub-grade	1.5	1.5
	2. " " track	8.2	5.0
	3. " " fences, crossings, etc.	.3	.2
(e)	4. " " ground return circuit	—	*
(e)	5. " " third rail	—	*
(e)	6. " " feeder lines	—	*
	7. Renewal of rails	4.0	2.0
	8. " " ties	3.0	.5
	9. " " ballast	1.0	1.0
(e)	10. " " poles and insulation of third rail	—	*
(e)	11. " " third rail	—	*
(e)	12. " " feeders	—	*
	13. Repairs " masonry, bridges and trestles	2.0	1.5
	14. " " buildings	2.0	2.0
	15. " " signals	1.0	1.3
	Total,	23.0	15.0

(*b*)	Train expenses.		
(s)	1. Fuel for locomotives	8.0	—
(e)	2. " " power stations	—	*
	3. Water-supply	.6	1.0
	4. Oil and waste	1.0	1.0
(s)	5. Repairs of locomotives and tenders	6.0	—
(e)	6. " of electric motors	—	*
	7. " of passenger cars	3.0	3.0
	8. " of freight cars	6.0	—
	9. Use of foreign passengers and freight cars	2.0	—
(s)	10. Locomotive services (wages)	7.4	—
(e)	11. Motor car services (wages)	—	3.0
	12. Passenger train services (wages)	3.0	1.0
	13. Freight train services (wages)	5.0	—
(e)	14. Repairs of power plants	—	*
(e)	15. Power station services [wages]	—	*
	Total,	42.0	9.0
(*c*)	Station, terminal, taxes, and general expenses.		
	1. Agents and station services (wages)	13.0	3.0
	2. Station supplies	3.0	.5
	3. Telegraph	1.0	1.0
	4. Taxes	3.5	3.5
	5. General officers and clerks	3.5	2.0
	6. Legal	.5	.5
	7. Insurance	.3	.3
	8. Stationery and printing	.7	.2
	9. Agencies and advertising	2.0	.5
	10. Contingent and miscellaneous, not included elsewhere	6.5	6.5
	Total,	34.0	18.0
(*d*)	Accidents, loss, and damages.		
	1. To freight	.3	—
	2. To passengers	.4	.4
	3. To property owned	.2	.2
	4. To property not owned	.1	.1
	Total,	1.0	.7

NOTE: (s) indicates the item that applies to steam road only.
(e) " " " " " electric road only.
— " " " does not apply in that column.
* " " " is to be added later.

SUMMARY:

(Figures give %.)	(*a*)	(*b*)	(*c*)	(*d*)	TOTAL.
Column No. 1	23	42	34	1	100
Column No. 2 (omitting items applying to an electric road only)	15	9	18	.7	42.7
Column No. 2 (per cent. difference from Col. No. 1, being allowance for items applying to electric roads only)	8	33	16	.3	57.3

By examination of the above table it may be seen that our proposed road should save 57.3 per cent. of the expenses of the present

steam railway, and that this saving can be used to provide for these items belonging to the electric road only,—namely, (*a*) 4, 5, 6, 10, 11, and 12, and (*b*) 2, 6, 14, and 15.

We can take the cost per train-mile in present steam-railway practice at 60 cents, or 2 shillings 6 pence; considering the engine as a car and considering a train as made up of four cars behind the engine, we have 12 cents, or 6 pence, per car-mile as the average practice on a well-managed steam railway. If the above savings balance the additional items chargeable to the electric road, the expenses would be the same. An examination of the items leads one to believe that they would; let us assume, however, that our expenses would be not less than 15 cents per car mile, or twenty-five per cent. higher than those of present steam-railway operation. Car labor on our present street railways, with short headways, amounts to about 42.5 per cent. of the total cost per car-mile at a speed not exceeding fifteen miles per hour, theoretically varying inversely as the speed. Remembering the high speed proposed, the estimate of cost should not be far from the truth. The total operating expenses would, therefore, amount to $6,515,250 (£1,303,050) per annum. To this must be added (*a*) interest on floating debt, (*b*) interest on bonds, and (*c*) sinking fund. We may assume that, if the road were financed on a sound basis, somewhat after the policy of the Pennsylvania Railroad, $100,000,000 of gold bonds would be issued, running for 100 years at three per cent., $100,000,000 of preferred non-cumulative four per cent. stock, and $100,000,000 of common stock. On this basis the additional charges would be about $3,750,000 per annum, making the "total expenses" per annum about $10,265,250 (£2,053,050). Add to this a dividend of four per cent. ($4,000,000) on the preferred stock, leaving the common stock earnings to the future, we have a total of $14,265,250 (£2,853,050) per annum as the gross receipts which must be obtained to make the enterprise a paying investment. The gross receipts from 73,000,000 passengers per annum at 20 cents (10d) each would be $14,600,000. Summarizing, we have:

Gross receipts	$14,600,000	£2,920,000	100%
Operating expenses	6,515,250	1,303,050	44.6%
Fixed charges	3,750,000	750,000	25.6%
Profits	4,334.750	866,950	29.8%

Comparing the percentage results with present steam-railway returns, we seem to be low in operating expenses, high in profits, and about right in fixed charges, while, comparing with street-railway returns, we are low in fixed charges and operating expenses and high in profits. Such comparisons lead to erroneous conclusions, for percentage of

gross receipts is always improperly used, and often leads to unfortunate conclusions. This is readily seen by asking the question: "What would the expenses be, were the same car-mileage maintained and there were no passengers (gross receipts)?" the obvious answer being that they would not change materially.

Statistics do not give exact figures of the travel between terminals on the two steam roads connecting the cities, but, assuming twenty trains of five cars each in each direction on both roads, with allowances for empty seats, it is conservative to place the fares at 5,000 per day, which, at $2.00 each, give annual gross receipts of $3,650,000, the total number of passengers being 1,825,000. (United Railroad of New Jersey returned $6,906,923.59 receipts from passengers in 1895.) Where present steam railways have been paralleled by electric roads, giving quick, frequent, and "leave-at-your-door" service, with low fares, not only has the steam road lost its local traffic, but the electric road has induced a travel which did not exist. The increased travel of the electric road has been anywhere from fifty to several hundred times the former travel on the steam roads, depending upon local conditions, and in most cases with a difference in fares in a ratio not exceeding 1 to 4. In the suggested case the fares are as 1 to 10, and, should forty times the passengers assumed as riding now be carried, the gross receipts would amount to that estimated. Looking at it from another standpoint, we have the following table:

Road No.	Total Pop. of Towns Connected, U. S. Census 1890.	Total Passengers Carried 1896.	No. of Rides per Capita per year of total Pop.
1	504,204	26,791,811	53
2	149,762	8,205,411	54
3	41,937	2,366,481	56
4	37,210	1,453,567	38
5	37,185	1,114,245	29
6	34,375	1,388,968	40
7	29,306	2,148,723	73
8	23,745	1,367,851	57
9	20,638	508,172	24
10	18,887	986,608	52
11	17,693	468,472	26
12	16,418	1,015,797	61
13	16,311	1,033,977	63
14	15,714	912,930	58
15	14,884	1,022,432	68
16	13,137	1,309,421	99
17	10,887	813,689	74
18	9,473	1,426,690	150
19	8,973	655,556	73
20	5,721	684,654	119
21	5,451	738,529	135

The population connected in this case will amount to 5,500,000. If this population should be carried fourteen times, it would give the numbers of fares estimated. The lowest number given in the table, 24, would produce 132,000,000 fares, and the highest, 150, would give 825,000,000 fares for the case under discussion.

The fundamental and principal laws of electric-railway passenger travel, either within one community or between two communities, can be stated as follows:

1. It varies directly with the population, increasing faster than the inhabitants, unless modified by distribution or density.

2. It varies inversely with the average distance (time) each passenger is carried, presumably more rapidly than these shorten; distance and time are synonymous, for the result to the passenger is the same, whether he is carried 85 miles in 36 minutes, or only 12 miles.

3. It varies directly with the frequency of the service, presumably with a rapidity less than that with which headway is shortened.

4. It varies directly as the approach to "leave-at-your-door" service, but according to no known law.

5. It varies indirectly with the total cost of transportation, increasing less rapidly than the total cost falls; note that "total" cost is the important factor, and not the cost per mile.

6. It varies directly as the density of the population, the increase being probably less rapid than the increase of density.

7. It varies with the distribution of population. A long, narrow town gives more rides *per capita* per annum than a square town.

8. It varies with the character of the industries in the community.

One might argue that Philadelphia, with its 1,500,000 inhabitants, and its resources making it independent, would not conform to these laws. If this were a valid argument, it would equally apply to cities of more than 100,000 people. The last table, however, disproves this.

We believe that we have shown that headway and power questions can be solved, and that the cost of construction is not excessive; we have estimated expenses liberally, and have under-estimated probable travel; and we are convinced, for reasons that cannot be discussed now, that even a higher speed can be maintained, thus reducing the elapsed time and adding to the chances of success, but necessitating more tracks. The elimination of the distance by reduction in time would unquestionably make Philadelphia one of the suburbs of New York, for the former is naturally a manufacturing and agricultural center, while the latter is the financial and commercial center of the United States. The tendency of the age is concentration at centers, not only of population, but of wealth and special vocation, with the necessity of rapid inter-communication.

THE ECONOMICAL GOVERNING OF STEAM ENGINES.

By John S. Raworth.

WHEN James Watt bequeathed the steam engine to the human family, it was as nearly perfect as the materials at command and the conditions of its manufacture permitted. It was fitted with a speed-governor, the excellence of which is attested by the fact that, so long as engineers were limited by low pressure, no better governor was required or sought; even the exigencies of high pressure and high speed have not yet driven or induced inventors to abandon the main principle of Watt's governor.

All governors control speed by varying the mean pressure applied to the pistons of the engine, either by throttling the supply or by varying the time during which in each stroke the full pressure is permitted to have access to the cylinder; but the controlling mechanical device always includes two equal and opposite masses revolving round a shaft or spindle driven by the engine, the centrifugal forces of the said masses being opposed by gravity or springs.

The secret of good governing—*i. e.*, perfect regulation of speed—is now so well known that disquisitions on the construction of governors have ceased to command the interest with which at one time they were followed. The outcome of experience is that the power of a governor must be so great that its own internal friction plus the external work it has to perform shall be a negligible quantity. This fact being well understood, the chief interest nowadays centers in the economic problems involved in the two available methods of governing,—namely, throttling, and automatic variation of expansion. While there is no doubt that Watt is the father of the former, it is equally certain that we are indebted to Corliss for the latter.

Corliss achieved his success through a clear appreciation of the principle, or, rather, the limiting condition, enunciated above. He reduced the external work imposed upon the governor to an infinitesimal amount, thus leaving the centrifugal part of the arrangement little or nothing to do but to overcome the friction of its own joints.

The Corliss engine, however, reigns supreme, not simply because it maintains an even speed, but rather because that more excellent feature is combined with the highest development of the economic advantages derivable from the automatic variation of expansion. But an engine may be governed by "automatic expansion" without any development of its economic advantages; thus the door is opened

to controversy, and the whole question of throttling versus automatic expansion is being discussed anew, as though we were not the sons of our fathers, who all died in faith.

Perhaps the most curious feature of this controversy arises out of the fact that it originated in Willans, or, more correctly, that the state of mind which has rendered such controversy possible is due to a complete misunderstanding of Willans's work and teaching, for Willans's two classical papers, read before the Institute of Civil Engineers in 1889 and 1893, respectively provide the most complete armory of weapons for the discomfiture of all advocates of throttling, and the value of the facts brought to light by the tabulated results of the experiments is only enhanced by Mr. Willans's deductions therefrom, showing that the advantages to be derived from automatic expansion may very easily be lost by bad design or careless construction.

The adaptation of the steam engine to the generation of electrical energy has vastly improved the details of engine construction, especially in small sizes; it has also improved our knowledge of the laws of steam consumption at various loads, concerning which very little was known twenty years ago; and it was not until April, 1891, that this subject was elucidated by a gleam of genius which will probably continue to keep Mr. Willans's memory green long after his greater works are forgotten. It was during the discussion on Mr. Crompton's paper on the "Generation and Distribution of Electrical Energy," and after disappointment had been expressed by several speakers at the heavy consumption of coal in electricity works, that Mr. Willans propounded the now famous Willans law, confirmed by a complete series of experiments on throttle-governed engines.

In his own words, "with a fixed cut-off a certain quantity of steam was used to drive the engine doing no useful work, and, after that, each horse-power was obtained at a constant rate."

The most economical load is, therefore, the full load, and reduction of power by throttling increased the consumption per horse power, and to such an extent that Mr. Willans summed up the question thus: "The problem was not how best to reduce the power, but how to avoid reducing it." Yet, in spite of this, we are told that Mr. Willans leaned very strongly toward throttle-governing.

It is, of course, too much to expect that Mr. Willans would go out of his way to explain the merits of automatic expansion, since there had not, during his lifetime, been discovered any practicable method of applying automatic expansion to his engine; nevertheless the published results of the trials which he made with various grades of expansion, the cut-off being adjusted by hand, show clearly enough that a small high-speed engine of 40 h. p. could, if fitted with a really

efficient automatic cut-off, give results which would entirely remove the objections to working at reduced power so ably exposed by Mr. Willans. The results referred to may be found complete in Vol. CXIV, part 4, of the "Proceedings of the Institute of Civil Engineers."

The speed of the engine tested was 400 revolutions per minute, and the size of the low-pressure cylinder was such that one pound of mean pressure gave 0.86 i. h. p. Therefore, in the following quotations, only mean pressures are reproduced, they being proportionate and nearly equivalent to the actual indicated horse power.

The effect of the increased ratio of expansion and the diminished power, as shown by diminished mean pressure, on the consumption of steam should be carefully noted.

Reference letter	M2.	E3.	O3.	Z3.
Steam chest pressure (absolute)	135.69	139.63	139.92	119.63
Mean pressure	46.89	31.67	25.23	18.72
Pounds of steam used per i. h. p. hour	16.72	15.18	14.98	15.51
Fraction of full load	1.00	0.675	0.54	0.4

The result of 15.51 pounds of steam under Z3 is probably rather too high in comparison with the others, as the boiler pressure was 20 pounds lower.

The most interesting feature of these results is that the highest degree of economy per indicated horse power is attained in the trial O3 at 0.54 of full load and with a mean pressure of 25.23 pounds, which pressure is nearly identical with the mean pressure employed in cotton-mill engines, which are sold by the degree of economy attained per i. h. p.

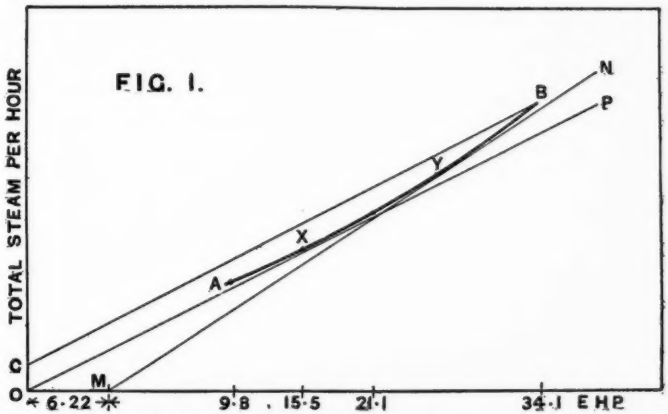
If it were practical to test the brake horse power of large engines, they could be sold by the economical result per brake horse power, and the best result could be attained only by the use of a higher mean pressure. The best illustration of this principle is afforded by the combination of an engine with a dynamo, in which the losses are known and made constant at all loads. Willans's experimental engine had an efficiency of 90 per cent. at 40 pounds mean pressure, and a good dynamo of corresponding capacity has an efficiency of 91 per cent. The combined efficiency is, therefore, 81.9 per cent. From this we deduce the mean pressure required to drive the diagram without external load thus:

$$\text{M. P.} = 40 \times \frac{100 - 81.9}{100} = 7.24.$$

Introducing this datum into the results quoted above from the Willans experiment, we obtain the following figures:

Reference letter	M2	E3	O3	Z3
Steam pressure (abs)	135.69	139.63	139.92	119.63
Mean pressure	46.89	31.67	25.23	18.72
M. P. to drive dynamo	7.24	7.24	7.24	7.24
M. P. available as electrical horse power at terminals of dynamo	39.65	24.43	17.99	11.48
Steam per i. h. p. hour	16.72	15.18	14.98	15.51
Steam per e. h. p.	19.8	19.6	21.0	25.3
Net output per cent.	100.	61.3	45.25	28.9

These results are shown graphically in the following diagram, in which the net outputs in e. h. p. are marked on the base line, and the total steam consumption are ordinates to the curve A. B. The i. h. p. equals e. h. p. + 6.22, the power required to drive the dynamo without external load. The Willans straight line is shown at C. B.



The line OP is drawn as a tangent to the curve AB; the point X, where it touches the curve, is the point of least consumption per i. h. p. The line M N is also a tangent to the curve A B, and its point of contact, Y, indicates the lowest consumption per e. h. p.

This diagram shows that reduction of power by automatic variation of expansion may be effected, not only without loss, but with a clear gain, down to 61 per cent.; and even as low as 45 per cent. the loss is not serious. On the other hand, they show that the makers of cotton-mill engines might raise their mean pressures with very great advantage to the purchaser, if the purchaser had sufficient knowledge to appreciate it. In the example O3 we have the highest economy of steam per i. h. p. at a mean pressure of 25.23 pounds, but in the example M2 we find the same engine giving more than double the *net* output with a smaller proportionate consumption of steam, but with a

mean pressure of 46.89 pounds. A very strange feature of this question is that we find in one small country two centers of steam-power development, only two hundred miles apart and connected by telegraph and telephone, in which the experts of one profess to believe that the highest economy is to be attained between 40 and 50 pounds mean pressure, and those of the other believe that it is to be attained at about 25 pounds mean pressure. While electrical engineers are doing all they know to avoid low mean pressures, the Manchester school pays immense sums for the privilege of using them,—that is to say, they build a 1,000-h. p. engine and work it at six or seven hundred, in order to enjoy the satisfaction of imagining that the engine is economical; and they will continue to do so until buyers learn that there are more things in this world than are visible to the naked eye.

The mill owner or electrical engineer, either as the user or as the intending purchaser of an engine, will very naturally, at this point, ask the question: What is the teaching of the foregoing, as a rule for my guidance in choosing a system of governing; what is the most economical mean pressure to adopt? Unfortunately there is no short answer to that question; it is influenced by boiler pressure, by back pressure, by the mechanical efficiency of the engine, and by the character of the probable variations in load. It will, however, enable any one interested in the question to obtain an answer for himself, if he supplies the information on these points, and applies it by the aid of the following conclusions: Every first-class engine has a curve of steam consumption approximately similar to the curve A. B. (Fig. 1), and it will be observed that for a certain distance between X and B it is nearly coincident with the line M N. Within these limits of practical coincidence, the steam consumption per effective horse power does not vary sensibly; it is, therefore, of great importance to confine the ordinary variations in power between these points. For cotton-mill driving the most economical point should be chosen for the ordinary full load, but for electric traction a much lower point should be chosen, in order to provide a larger margin of power for emergencies. On the other hand, electric-light engines should carry the normal load at a very high mean pressure (even beyond the economical limit), so that a great reduction in power may be made without serious loss of efficiency.

It may not be possible for the steam-engine user to fix the ratio of expansion best for any particular case, or to dictate to engine builders the precise arrangements to be adopted to obtain the most economical mean pressure,—these are matters in which he will do best in all cases to appeal to the expert—but he will be able to decide for himself the policy most profitable to adopt.

THE GROWING IMPORTANCE OF CEMENT IN CONSTRUCTIVE WORK.

By Edward Wilkins Dewey.

THE past four years in the United States have been years of financial depression in every form of business. Factories have been forced to close, either from a lack of market for their goods, or from inability to compete in price with others who have preferred to keep in operation even at a loss. Although there has been considerable activity in government works and municipal improvements, railroad building has been at a standstill, and all private enterprises requiring capital have been waiting for a return of confidence, and it is not too much to say that nearly every manufacturer has felt keenly this state of affairs.

The manufacture of Portland cement has been one of the exceptions to this rule. The progress of this industry had long been retarded in the United States by lack of the knowledge and perfection attained by the European, together with the hesitation of capital necessary for an uncertain investment. When once it gained a foothold, it went forward with gigantic strides, and now is one of the great American industries. The product, under the most rigid tests, has proved equal, in every particular, to the leading brands of imported Portland cement, which it is rapidly superseding.

The annual reports of the United States geological survey estimate that the sixteen small factories in the United States in 1890 produced 335,500 barrels of Portland cement; in 1894 twenty-four factories produced 798,755 barrels; and in 1896 twenty-six factories produced 1,543,023 barrels; while an estimate for 1897 will not fall far short of the very respectable showing of thirty factories producing 2,304,000 barrels. This is the result of the more general use of Portland cement in all branches of building and engineering construction, the increased excellence of the domestic product, and the decrease in the price of the imported as well as the domestic article. With the return of prosperous times to which all indications point, the demand will be greatly increased, and will tax American manufacturers to their limit.

Until the last decade the use of Portland cement in the United States was considered a luxury by even the best engineers. The price ranged from $2.75 to $3.75 per barrel, delivered at the port of entry, to which was added the cost of transportation to its ultimate destina-

tion; if this happened to be west of the Mississippi river, the cost per barrel was frequently doubled, and in certain sections as much as $8.00 and $10.00 per barrel has been paid for it. The domestic cement was known as the hydraulic (natural rock) cement, and the little Portland cement that was manufactured was of a low standard, creating a prejudice which it has been extremely difficult to overcome.

In many sections of the United States are to be found inexhaustible deposits of limestone containing so much magnesia that it is unfit for the manufacture of Portland cement; but it is easily calcined and ground, and, in a neat test, it developed a tensile strength in seven days of 200 pounds, and in twenty-eight days of 300 pounds. Since 1880 this "Rosendale" or natural rock cement has been used in large quantities. In 1896 the United States produced and used 7,960,450 barrels, at a valuation of $4,049,202, or a trifle more than fifty cents per barrel, in bulk at the mill.

Germany produces annually about 13,500,000 barrels of Portland cement, exporting about 3,000,000 barrels, and consuming the remainder. It is estimated that the United States will consume in 1897 about 4,613,830 barrels of Portland cement, and about 8,000,000 barrels of natural rock cement,—a consumption nearly equal to that of Germany. In Germany the use of rock cement has practically ceased, as good Portland cement can be obtained at the works at $1.25 to $1.50 per barrel. In consequence of improved methods the cost of manufacturing in America is constantly diminishing, and, if the present fierce competition continues, German prices may soon be reached; then the Portland cement will gradually take the place of the rock cement, and drive it out of the market, as it has done in England and Germany. The excellence, however, of American natural rock cement, and the many ways in which it can be used advantageously, leads me to believe that it has obtained a firm foothold in the United States, which it will keep, regardless of the many predictions of the Portland cement adherents.

Although the apparent cheapness of the natural rock cement induced many American engineers and architects to specify Rosendale whenever practicable, they are now coming to the conclusion that, on account of the increased power of Portland cement for "taking sand," the latter is more economical at much greater cost; so that, in present construction, the practice of the best engineers is to give Portland cement the preference, whenever practicable. Hundreds of thousands of barrels of Portland cement form the concrete foundations of the huge office-buildings erected in the larger cities, while the brick and stone of the superstructure are laid in Portland cement,

whereas in former years quicklime was used for the purpose, and, until recently, Rosendale cement. In all government works, such as concrete break-waters and light-house foundations, where the strongest cement is necessary on account of exposure to the elements and to the action of the sea-water, preference is given to the American Portland. It is believed that the day is not far distant when manufacturers in the United States will not only drive all the imported cement out of the market, but, by Yankee skill and enterprise, so reduce the cost of manufacture that they may even ship a surplus to Europe.

The duty imposed on cement by the McKinley bill in 1889 was eight cents per one hundred pounds which has remained unchanged through the Wilson and Dingley tariffs. During the recent tariff debate an effort was made by several cement manufacturers to increase the duty from thirty cents to fifty cents per barrel, arguing that the importation was 65 per cent. of the annual consumption, and that the infant industry needed further protection. This was opposed by several manufacturers, on the ground that, if there were a surplus, the United States could now sell their product in England at a profit. It was also stated that an increase in the duty would not be a benefit, as the competition among the American manufacturers is so strong that, on large contracts, the best grades of American Portland are offered at a price per barrel at least fifty cents lower than that demanded by foreign competitors.

The following table shows the number of works in the United States, and the relative production of the various sections:

Number of works and relative product of Portland cement at various localities in the United States, during the years 1890, 1894, and 1897.

UNITED STATES REPORTS.

	1890			1894			Estimated. 1897		
	Number of works	Product Barrels	Per Cent.	Number of works	Product Barrels	Per Cent.	Number of works	Product Barrels	Per Cent.
New York....	4	65,000	19.4	4	117,275	14.7	7	306,900	13.3
Lehigh County, Pa., & Phillipsburg, N.J.	5	201,000	60.0	7	485,329	61.2	8	1,520,300	66.0
Ohio.....	2	22,000	6.5	4	80,653	10.1	5	192,000	8.3
All other sect's.	5	47,500	14.1	9	115,500	14.0	10	285,100	12.4
Total.....	16	335,500	100.0	24	798,757	100.0	30	2,304,300	100.0

The district showing the greatest growth of the industry is in Lehigh county, Pennsylvania, where the factories have been enlarged again and again, until one company is producing about 2,800 barrels daily,—equal to 840,000 barrels per annum, or 36½ per cent. of the annual output estimated for 1897. Phillipsburg, New Jersey, also shows a gratifying development, and the two districts represent 66

per cent. of the entire production. The reason for this lies in the fact that there are found in that district enormous deposits of limestone nearly free from magnesia, and containing almost the correct proportion of clay, making a natural "raw mix" for Portland cement. It is not unlike the limestone found in Belgium, but more homogeneous. Before grinding, chemical analyses of the raw material are constantly being made, and such elements as are lacking in the various strata are supplied, to make a uniform product. The district is very accessible, and is traversed by two large trunk line railroads. The freight rate per barrel to New York is fourteen cents; to Chicago, forty-eight cents.

In many parts of the country there are, without question, limestone formations suitable for the manufacture of Portland cement, and these will be developed, in the course of time, yielding a large output.

The bulk of the Portland cement manufactured in the United States is made from argillaceous limestone; about one-fifth is made from "marl," or fresh-water chalk, formed from the decomposition of fresh-water shells. The following table shows the comparative product from limestone and marl:

UNITED STATES REPORT.

	1896.		1897.	(Estimated)
	No. of factories.	Barrels.	No. of factories.	Barrels.
Product from Limestone....	18	1,208,234	20	1,783,100
Product from Marl	8	334,789	10	521,200
	26	1,543,023	30	2,304,300

The marl deposits, as a rule, are usually confined to inaccessible tracts of low, marshy land of several hundred acres, not of sufficient magnitude to warrant the erection of large plants.

One of the most successful plants using the marl is in operation at Wayland, New York; its capacity will be doubled during the coming season. Intermittent vertical kilns are used, and the product is a heavy, slow-setting cement, not unlike the best brands of German cement. Several deposits are being worked successfully near Syracuse, New York. Various deposits of marl in Ohio and Michigan have recently been exploited, and it is stated that small plants will be erected before the end of 1897.

The largest deposit of marl known to the writer is at Montezuma, New York, about thirty miles west of Syracuse, on the Erie canal and New York Central Railroad, containing about 4,000 acres. The marl varies from one foot to thirty feet in depth; is almost white, containing about 85 per cent. carbonate of lime and 1 per cent. of magnesia; is free from grit and sand; and is, in every way, an excel-

lent cement material, existing in practically inexhaustible quantities. Underlying the marl is a deposit of clay three feet in thickness. This tract of marl land is under option to New York capitalists, who propose to erect large works in the near future.

The United States is the only country where the rotary kiln is extensively used for burning the cement. The old-time vertical intermittent kiln and the modern Schofer continuous kiln have their adherents, but now the product from the rotary furnaces nearly equals that of the vertical kilns, as is shown by the following table:

	1896. Barrels.	1897 (Estimated.) Barrels.
Rotary furnaces	632,370	1,059,265
Vertical kilns (continuous and intermittent)	910,653	1,245,035
Total	1,543,023	2,304,300
Per cent. of total product burned in rotary furnace.	41.0	48.0

The great increase in the use of the rotary kiln is in the Pennsylvania factories, where it is most successful; the limestone makes a clinker at a lower temperature than is required with other limestones and marls. The rotary furnace has not been successful in burning the marls of New York State; whether the marl, because it contains a large percentage of moisture, requires a greater temperature than can be had in a rotary furnace to obtain a clinker of sufficient density, or needs to be burned longer in a vertical furnace, is a question.

The limestones back of Rondout, New York, were too hard to be burned in a rotary furnace, and the plant erected there was a failure. So was a plant erected at Colton, California; the limestone would not melt, until the owners looked over the files of the patent office and found a process (which they adopted) of adding to the "raw mix" about 3 per cent. of fluor-spar, which acted as a flux, and yielded as high a grade of Portland cement as was ever made in the United States. The city engineer of Los Angeles, California, gave it a year's test simultaneously with the best brands of imported cements, and in every particular the Colton cement was found superior.

The imports of Portland cement in 1896, as given by the United States bureau of statistics, were 2,989,597 barrels,—but a slight variation from the preceding year. But there is a marked decrease in the year 1897. The United States treasury department report the importation for the fiscal year ending June 30, 1897, as 2,348,020 barrels,—a decrease of 07.6 per cent. The amount of cement imported into the United States for the past six years has been very uniform, the total amount in 1896 being the same as in 1891. The following table shows the imports of cement into the United States for the fiscal years ending June 30, 1895, 1896, and 1897, by countries.

Country.	1895. Barrels.	1896 Barrels	1897. Barrels
United Kingdom	806,884	742,169	460,592
Belgium	708,875	742,237	645,780
France	22,837	26,714	32,124
Germany	1,299,919	1,366,909	1,160,905
Other Europe	141,909	99,184	39,741
British North America	10,416	11,334	6,873
Other Countries	6,555	1,050	2,005
Total	2,997,395	2,989,597	2,348,020

An analysis of the above table shows many interesting points, the most striking being the constant decrease of the importation from the United Kingdom and the constant increase in the percentage of the German cements. The percentage of importation furnished by England in 1895 was 27; in 1896, 24; in 1897, 19. Germany, in 1895, supplied the United States with 43 per cent. of the total imports; in 1896, with 46 per cent.; in 1897, 49 per cent. It is not many years since their positions were reversed, but one need not search far to find the cause.

In spite of the fact that the English cement has been offered in the open market at fifteen cents a barrel less than the price asked for the best American brands, and seventy-five cents less than the price asked for the best grade of German cement, Germany continues to supply nearly half the amount of the cement imported into the United States, because the German manufacturers have advanced steadily in their methods and their product, leading the world to-day, as England led it twenty years ago. The English, on the other hand, are proverbial for their slowness in adopting new and advanced methods, which was never better exemplified than in the above instance. The New York agent of one of the large English manufacturers of Portland cement told the writer several years ago that he had begged his company to improve the quality of its cement. The management was highly incensed, and wrote in rebuke, saying that they had made cement for one hundred years, and it had always been considered the best that could be made, and, when such engineers as Sir———— and Sir ———— had used it and pronounced it good, it surely ought to be good enough for the American engineers, and, if they didn't want it, they could leave it alone. It reminds one of the story of the country-hotel proprietor who thus rebuked a criticising guest: "Say, stranger, you must be mighty particular; fifty men have used that towel, and you are the first one to find fault!"

The sharp note of alarm, however, was sounded in 1895 by the English authority, G. R. Redgrave, in the preface to his book, "Calcareous Cements," in which he says that he regards the present time as a very critical period in the history of the cement trade; that

England, the original seat of the manufacture, has been distanced in certain directions, in consequence of the superior scientific skill and energy of foreign rivals; and that nothing but the formation of a powerful confederation of cement-producers and cement-users, such as exists in many of the most enlightened countries, will extricate it from the present difficulties, or ward off times of even greater depression.

Although the percentage of imports of Belgian cements shows an increase during the past three years, it is not highly esteemed in America, being considered second-grade. The confederation of Belgian manufacturers, under the name of Hammer Societies, is making great efforts to extend the trade by offering their product at a lower price than that asked for other imported cements, as they can well afford to do. In Belgium there are large deposits of argillaceous limestone, not unlike those of Lehigh county, Pennsylvania; in composition it varies but slightly from the "raw mix" of Portland cement, containing clay and carbonate of lime, with a small amount of magnesia. It melts easily, and, by careful combination of different strata, may be burned directly into Portland cement, without preliminary treatment. It seems impossible, however, to keep it to a fixed standard, owing to the variations of its chemical composition.

Sweden, Denmark, and other districts included under the head of "Other Europe," show a marked decrease from 141,909 barrels in 1895 to 39,741 barrels in 1897. The Danish cement is highly esteemed on account of its excessive fineness, and every barrel can be sold at a premium. Eight hundred pounds were imported from Italy at a valuation of $3.00.

The principal ports of entry are New York, with a record of 1,036,000 barrels of cement in 1896, at a valuation of $1,350,114.00; San Francisco, 361,100 barrels; Baltimore, 341,000; New Orleans, 306,000; Boston, 258,490; twenty-six other ports, 436,000.

The American manufacturer has many advantages over his foreign rival as to price, quality being equal; not only must the duty of thirty cents per barrel be paid on imported cements, but they must be shipped in barrels, on account of the long ocean voyage. By shipping in bags, which are returnable, American manufacturers can reduce the price to the purchaser by an amount equal to the cost of the barrel,—twenty-five to thirty cents. The ocean freight varies considerably, depending on conditions; sometimes vessels pay for the privilege of carrying it as ballast, as it is very heavy and easy to handle; again, the freight on it is as high as thirty-five cents a barrel.

The relation of domestic production to importation has varied

considerably, the imports remaining practically constant, and the domestic production increasing from 13.2 per cent. in 1891 to 49.9 per cent in 1897, as shown by the following table:

	1891. Barrels.	1893. Barrels.	1895. Barrels.	1896. Barrels.	1897. Barrels.
Production in the United States	454,813	590,652	990,324	1,543,023	2,304,300
Imports	2,988,313	2,674,149	2,997,395	2,989,597	2,348,020
Total	3,443,126	3,264,801	3,987,719	4,532,620	4,652,320
Exports	....	14,276	83,682	85,486	38,490*
Total consumption	3,443,126	3,250,525	3,904,087	4,447,134	4,613,830
Percentage of total consumption produced in the United States	13.2	18.2	25.3	34.7	49.9

* Returned under "Lime and Cement" prior to July, 1896.

This table shows that the percentage of the total consumption produced in the United States has increased 15.2 per cent. in 1897 over 1896, and that the exports have decreased from 85,486 barrels in 1896 to 38,490 barrels in 1897. The exports of Portland cement before 1897 were mixed with the exports of lime, so that the returns for 1897 are correct; previously the returns were incorrect. The total consumption in the United States shows an increase in seven years of 1,170,000 barrels, and an increase in domestic production of 1,849,487 barrels. This consumption of Portland cement will, no doubt, be greatly increased within the next few years.

The testing of cement has received increasing attention from engineers and engineering societies. The American Society of Civil Engineers has led in this movement; the rules for testing cements, adopted as standard by the committee appointed in 1885, were used extensively for a number of years, but, as the requirements increased, the specifications became more rigid, till it was voted by the society, at its annual meeting in January, 1897, to appoint a committee to draft a new set of resolutions, in conformity with the best practice here and abroad.

The highest requirements can be met without difficulty by most of the leading brands of domestic Portland cement. The rigid tests imposed by American engineers have resulted favorably to the cement manufacturers, having served to show the weakness of certain brands of imported cements, and the almost unexpected strength developed in the domestic article.

IRON-ORE LOADING ON THE AMERICAN GREAT LAKES.

By H. J. Slifer.

THE extreme industrial importance which, as Mr. Jeans ably shows elsewhere in this magazine, now attaches to supremacy in the iron trade, and the recent remarkable developments exhibiting the western continent, not only as sufficient to itself in iron production, but as a competitor in the markets of Europe for the sale of iron and steel in many stages of manufacture—these, and similar causes, lend a special value to the study of iron mining and metallurgy, and particularly to those methods of intensified production and labor-saving manipulation which are characteristically American, and which have given the United States a position far in advance of that which would be expected from the comparatively recent entry of the country upon iron making, or from the general impression as to its labor conditions.

These characteristics are evident in every stage, from the getting of the ore to the sale of the finished product. And beyond this the value of iron; its necessity to mankind; the many processes it undergoes for use in every department of economics,—make the study of it in its transition from a lump of ore to the hair-spring of a watch most interesting and instructive.

From the mine to the dock may then be termed the first stage of its journey; let us begin it in the iron regions of Lake Superior.

Until the last two decades, Northern Wisconsin was considered a trackless wilderness, although for years a scientist, Increase A. Lapham, intimated that vast deposits of iron lay buried in the range that crosses the boundary line of Wisconsin and the northern peninsula of Michigan. It remained, however, for Nat Moore, a roving adventurer, to make the discovery that sent scores of prospectors to the region between Penokee gap and Lake Gogebic. His first trip was in 1872, but it was some years later that he found clean hematite, high-grade bessemer ore under the roots of a fallen tree. Then followed the great Gogebic boom, one of the most conspicuous episodes in the development of northern Wisconsin. The year 1886 found this at its height, and in May of that year it was estimated by a conservative newspaper that the value of the mines was $24,000,000. The railroads that hauled the ore to the lake became the best paying in the United States, and towns sprang up like mushrooms. Fortunes were

RECORD OF ORE DOCKS ON THE GREAT LAKES.

RAILWAY.	LOCATION.	Dock No.	Length of Dock.	Width of Dock.	Height of Dock (Water to deck)	Number of Pockets.	Storage Capacity, Tons.	Height, Water to Ctr. Hinge Hole.	Length of Spouts.	Angle of Pockets.
Chicago & North-Western Ry.	Ashland, Wis.	1	1404′	46′ 8″	54′ 0″	234	36,036	32′–10″	27′–0″	39° 30′
		2	1404	46 0	45 0	234	24,156	23 10	27 0	210 @ 42° 00 24 @ 45° 00
	Escanaba, Mich.	1	1104	37 0	48 6	184	24,104	28 10	21 0	39° 30
		2	1152	37 0	40 3	192	20,928	24 1	21 0	31° 26
		3	1356	37 0	52 8	226	30,284	31 2	27 0	45° 00
		4	1500	37 0	48 6	250	32,750	28 10	21 0	37° 53
		5	1392	37 0	53 3	232	43,152	28 6	21 8	40° 00
Duluth & Iron Range R. R.	Two Harbors, Minn.	1	1056	41 0	45 6	141	18,000	26 10	23 0	84 @ 37° 30 57 @ 32° 40
		2	1056	41 0	46 6	176	23,900	27 9	23 0	98 @ 37° 30 78 @ 32° 40
		3	540	49 0	51 6	90	16,000	28 10	23 0	38° 40
		4	1008	49 0	51 6	168	30,000	28 10	23 0	38° 40
		5	1008	49 0	54 0	168	33,000	30 0	25 0	38° 40
Duluth, Missabe & Northern Ry.	Duluth, Minn.	1	2336	52 0	53 0	384	57,600	30 0	27 9	45° 00
		2	1152	52 0	57 6	192	34,560	32 0	27 9	45° 00
Duluth, South Shore & Atlantic Ry.	Marquette, Mich.	1	1700	40 0	45 0	270	27,000	25 0		39° 00
		3	1200	53 6	37 0	213	12,780	23 0		
		4	1200	36 8	47 3	200	28,000	27 9	21 1	39° 45
Duluth, Superior & Western Ry.	Allouez Bay, Superior, Wis.	1	600	49 8	52 0	100	15,000	29 9	26 0	43° 21
			900	49 8	57 0	150	25,500	33 0	27 3	45° 00
Lake Superior & Ishpeming Ry.	Marquette, Mich.	1	1200	52 0	54 0	200	36,000	30 9	24 7	38° 45
Minneapolis, St. Paul & S. Ste. Marie Ry.	Gladstone, Mich.	1	768	37 0	47 0	120	15,000	26 8	21 8	40° 00
Wisconsin Central Lines.	Ashland, Wis.	1	1908	36 0	54 6	314	33,500	31 4	27 0	234 @ 42° 30 80 @ 50° 45

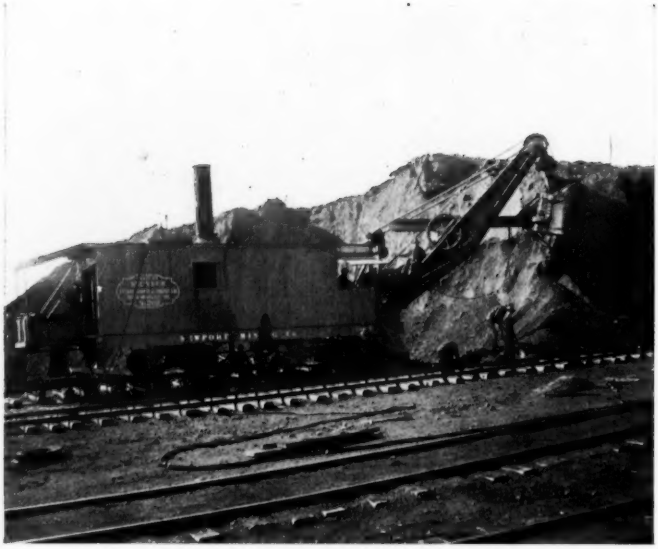
Compiled by Division Engineer, Ashland Division, C. & N.-W. Ry., Kaukauna, Wis., January, 1897.

A LINE OF SHAFTS AND STOCK PILE GROUND.

made while one slept, and the excitement was almost as great as that which accompanies the present exodus to the Alaskan gold fields.

Much might be written on the mining of the ore in the various

A STOCK PILE.

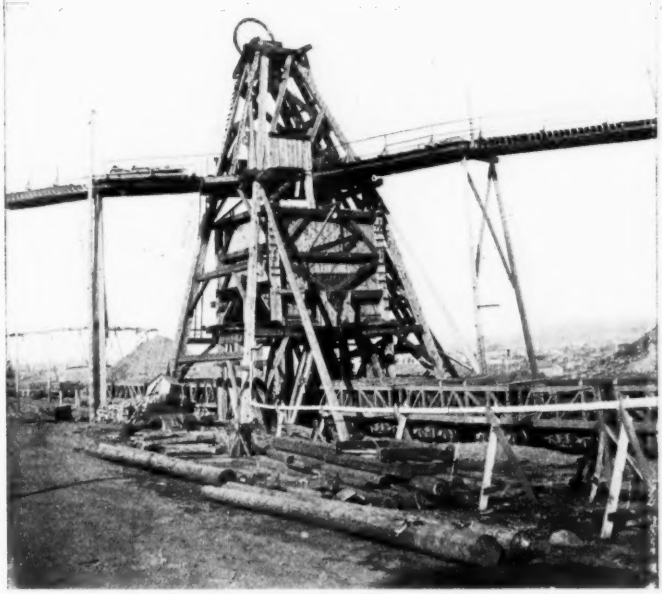


STEAM SHOVEL WORKING IN THE STOCK PILE.

LOADING ORE FROM THE STOCK PILE INTO CARS BY THE STEAM SHOVEL.

ranges,—the Marquette, Menominee, Gogebic, Penokee, Massabi, and Vermilion, each of which could be treated in an article by itself,—but it is the object of this paper to illustrate the methods in common use on the different ranges for handling the product of the mines.

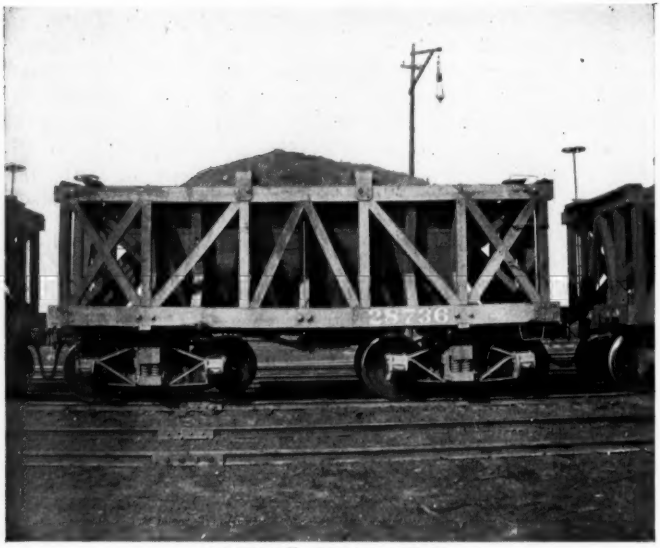
That the quantity is enormous is evident when we consider that the Norrie mine alone has shipped in one season more than a million tons. The *Marine Review*, in a late issue, estimated that the total



CARS BEING LOADED FROM POCKET AT THE SHAFT HOUSE.
THE OVERHEAD TRAMS LEAD TO STOCK AND WASTE PILES.

shipments for the present season will pass the ten-million mark, as up to September 1 there had been sent out 7,712,158 tons (gross). The bulk of the ore is mined in winter, when navigation on the lakes is closed, although some work is done the year round.

From deep shafts, some of which exceed 1,500 feet, the ore is raised to the surface, and stored in immense heaps, known as stock piles, being loaded into cars during the shipping season with the



A "JUMBO" ORE CAR, LOADED.

ordinary steam-shovel. Many tons, however, are loaded from the shaft-houses directly to the ore-cars through pockets, with which the houses are all equipped.

Some of the mines produce as many as eight grades of ore, each of these being loaded separately and the separation being maintained through the various handlings. As the cars are loaded and tagged,

A LOADED ORE TRAIN EN ROUTE.

ORE TRAINS IN THE YARD AT IRONWOOD, MICHIGAN.

they are gathered up by switching engines, and taken to the yards, where they are made up into trains of from thirty-five to fifty cars. These are equipped with appliances for quick handling, as delay might prove costly.

Nature has assisted the railroads in transporting these loaded trains, the grade from the mines being a descent; from the Gogebic mine to Lake Superior the fall is one thousand feet.

The details of transportation are in the hands of the vessel-owners

THE ASHLAND ORE DOCKS ON CHEQUAMEGON BAY, LAKE SUPERIOR, U. S. A.

and sales agents, who are in close touch with the superintendents of the several "docks," as they are generally, if rather loosely, termed.

On reaching the yards at the ore-docks, each car is carefully weighed, after which switching engines push the cars on the docks, and "spot" them over the pockets, the centers of which are spaced to fit the drop bottoms of the cars. The tracks over these pockets are so arranged as to allow the pocket to be "trimmed," by placing the car on the front or rear. The accompanying illustration of the top of a dock shows an arrangement which provides for three gages, with four rails, the center rails being used for gage on both sides.

THE TOP OF AN ORE DOCK, SHOWING TRACKS AND POCKETS.

The ore is then dumped into the pockets, each of which will hold from four to six cars, weighing on an average twenty tons each. The writer has seen four Jumbo cars, holding, on an average, 104,000 pounds, gross, all on a wheel base of twenty-five feet. It can be seen, then, that the structures over which trains of this character pass, and on passenger-schedule time, must be kept in good condition.

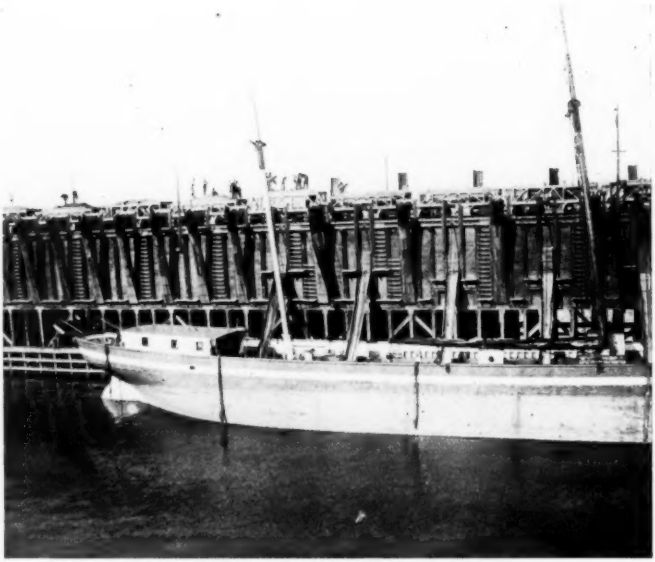
The number of the car, its weight, the class of ore, and the number of the pocket are all put on record in the superintendent's office, and from these are made up the cargo of each vessel.

The general construction of the several docks on the Great Lakes is the same, there being some differences in the minor details of hoisting apparatus, counter-weighting, etc. Among the later docks built

VESSEL LOADING AT THE ASHLAND, WISCONSIN, ORE DOCK.

are those of the Chicago & Northwestern Railway Company, at Escanaba, in Ashland, rebuilt and remodelled under the direction of Chief Engineer John E. Blunt and Principal Assistant Engineer Edward C. Carter, by Division Engineers Palmer and Slifer; these

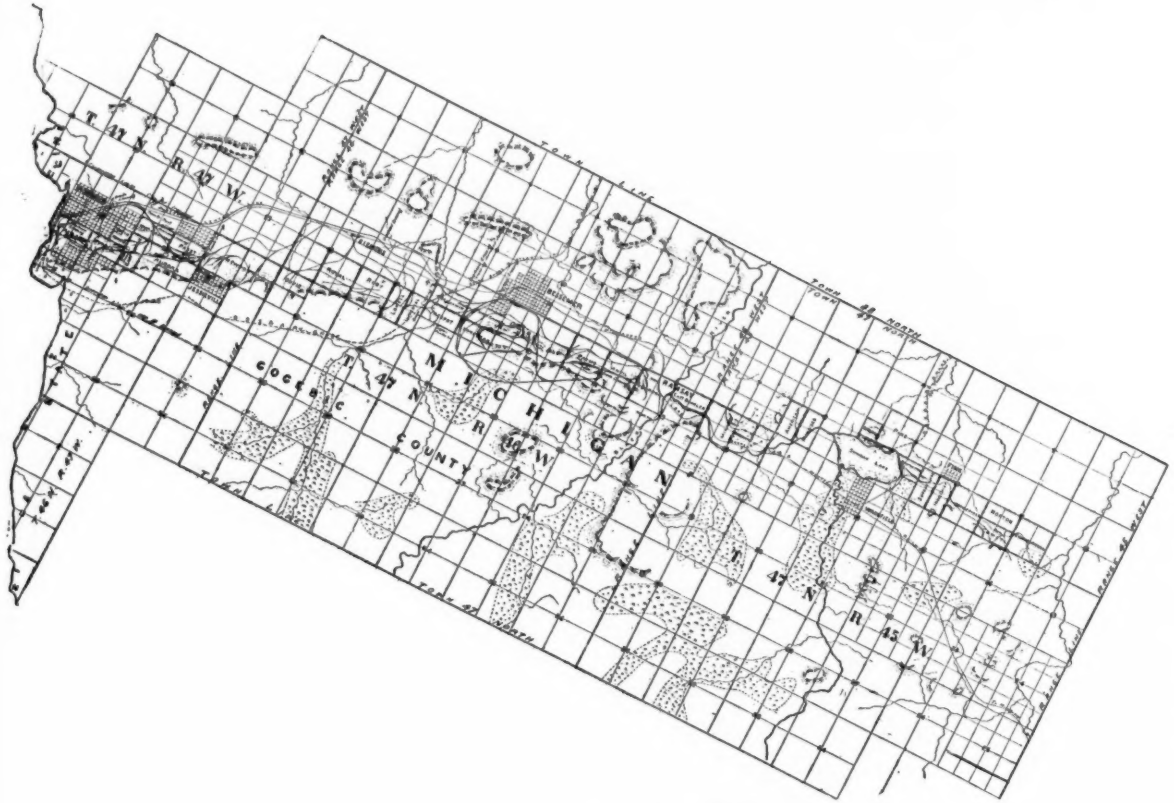
A VESSEL AT THE DOCK, LOADING FROM CARS THROUGH EIGHT SPOUTS AT ONCE.



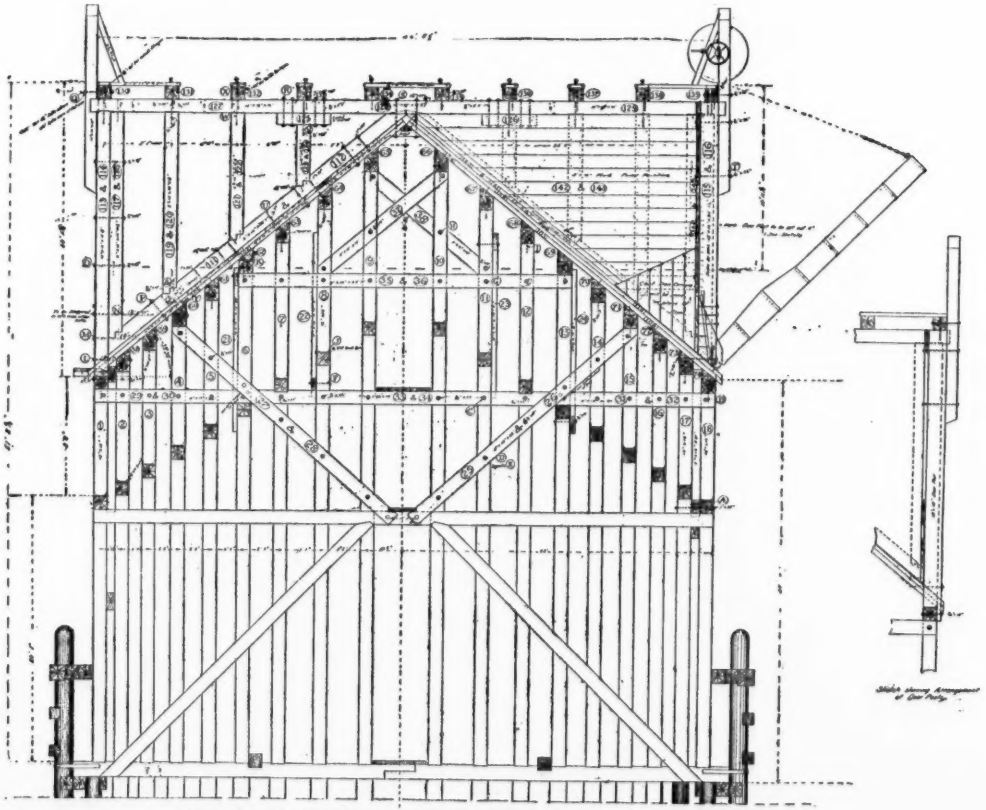
LOADING A VESSEL FROM CARS THROUGH THE POCKETS.

GEARING ON THE DOCK FOR RAISING AND LOWERING SPOUTS.

THE GOGEBIC IRON REGION. PORTION IN THE STATE OF WISCONSIN.



THE GOGEBIC IRON REGION. PORTION IN THE STATE OF MICHIGAN.



SECTION OF AN ORE DOCK, SHOWING ARRANGEMENT OF TRACKS AND POCKETS.

are shown in the "Record of Ore Docks on the Great Lakes" on page 276.

The docks consist of high, timber structures, supporting the tracks, from which the ore is emptied into the pockets, these being constructed with steel-clad sloping floors and maple corners, tending to carry the ore forward to the doors of the pockets, these being secured with large iron pins.

A boat, on reaching the dock, takes her place directly opposite the pockets from which her cargo is to be taken, and the spouts of such pockets as are to be opened are dropped into the hatchways, these being so constructed as to fit the docks, or, more properly speaking, the docks being built with pockets to fit the boats, twelve feet from center to center. The hoisting apparatus is made of steel, and is provided with counter-weights to assist in lowering and raising. Several appliances are in use for this purpose, but the same general principle is followed in every case,—a small cone wheel on the same shaft with the main gearing,—the only difference being in the location of the counter-weights and their construction. Some few of the older docks are not provided with the counter-weights, the spouts being raised and lowered by common gearing and main strength. Everything being ready, one of the laborers descends from the top of the dock to the platforms on a level with the door of the pocket, and removes the pin, when the ore is released, and transferred to the vessel. This method is sometimes varied by loading the boats directly from the cars through the pockets, as shown in the illustration. The "trimming" of the ore in the hold of the vessel is usually done by hand, but careful manipulation reduces this labor to a minimum.

A manifest is provided, and the ore then begins another stage of its journey, through the Great Lakes to some Lake Erie port, there to be reloaded into cars for its trip to the furnace.

ENGLISH GOODS STATIONS AND RAILWAY YARDS.

By Arch. R. Whitehead.

FOR some years after the first introduction of railways in England their owners did not work them, but were content to receive tolls for their use from any persons who cared to avail themselves of the facilities offered by the new and improved highways. Among others the coal-owners of Lancashire ran their coal along the railways in their own trucks, drawn by locomotives also belonging to themselves.

And for a considerable further period after the railway companies had found it desirable to undertake the conveyance, or haulage, of goods by their own servants and rolling-stock, they did not perform the services connected with their receipt and dispatch. They neither collected, delivered, loaded, or unloaded the goods entrusted to them for conveyance. These duties were left to the general carriers who had hitherto performed similar duties in connection with their business on the high roads and canals. And it was with these carriers that the public and traders dealt, and not directly with the railway companies, as at present.

The railway companies erected sheds in the large towns (or usually just outside them) for the purpose of loading and unloading, under cover, the trucks of merchandise brought to them. There were one or two short sidings laid down in front of the sheds, with a turntable and siding running into the shed. These were let to the carriers at an annual rent; in some cases, however, the sheds were erected by the carriers themselves on their own property purchased alongside the railway.

It was to these sheds that all goods to be forwarded were brought. The carriers weighed the goods, invoiced them, loaded the trucks, sheeted them, and handed them over, at the doors of the shed, to the railway company for conveyance or haulage. On the arrival of the trucks at their destination the railway companies transferred them to the carrier at the door of his shed, and the unloading, carting, and delivery were then performed entirely by the carrier.

This description refers only to the larger towns. At this time there was very little goods traffic of any kind at the roadside stations, and, in consequence, no sheds were erected at those places. Here only full truck loads, such as coal or agricultural produce, could be

received, and these were entirely loaded and unloaded in the open yard, by the consignors and consignees of the goods.

Miscellaneous consignments of ordinary merchandise belonging to, or to be sent to, different persons could not be dealt with at these roadside stations, there to be loaded together in one truck. It is obvious that much difficulty and loss would necessarily ensue, if the public were allowed free access to such trucks for the purpose of loading and unloading.

At the larger towns any full truck-loads were run into the sidings in the open yard, and there unloaded by the consignee. They were not brought into the carrier's shed.

Thus, in those days, what is called the "carted," or "shed," traffic was entirely in the hands of the general carriers, while all the work at the stations in connection with "station to station," or "yard," traffic was performed by the consignors or consignees themselves. The railway companies provided nothing more than the railway line, yard, and sidings, with the locomotive power and trucks; with that their duties ceased. They themselves undertook for the public nothing in the way of "terminal station service," as it is now called, and of course, as they had no warehouses, they could not warehouse any goods.

All this, however, is now changed. The public deal directly with the railway companies, who perform the whole of the services above described as being at one time undertaken by the general carriers.

That the change has been an advantageous one is indicated by a recent report by the board of trade, which, after a long and most exhaustive inquiry, stated that "we do not think it wise to encourage a system by which truck-loads of miscellaneous goods would be collected from several traders for delivery to the railway company."

An attempt will now be made to describe the manner in which goods traffic is dealt with by the railway companies at present.

The coal traffic should perhaps first be taken. It is by far the largest item in the class of "minerals," which contributed 72 per cent. of the tonnage conveyed in 1895 over the whole of the railways in the United Kingdom, there having been 240,250,000 tons of minerals carried in that year against 94,000,000 tons of general merchandise.

Coal is still always unloaded by the consignee, and is very often carried in owners' wagons. The accommodation usually provided consists of one or more sidings, each with a metalled roadway some thirty feet in width, running parallel alongside, to allow carts to draw up to the trucks in the sidings. There is also provided a strip of ground alongside the siding for the purpose of stacking the coal. As this is frequently traversed by carts, it is sometimes metalled or paved.

At some places coal drops are provided, and, where there is a large traffic, the sidings and carting spaces alongside are roofed over. The railway company's charges vary with the extent of the accommodation afforded. The coal merchants themselves erect at the smaller stations small timber offices for the use of their clerks, generally near the entrance to the yard, but at the larger stations more permanent offices are built. A weighbridge, for weighing carts, is always provided, and is placed at the entrance to the yard.

Sidings for coal, and indeed all sidings intended for trucks to be unloaded by the public or traders, are generally "dead-ended," and are laid down on a site quite clear of any shunting lines. When they are long, they are planned to allow of the removal and replacing of trucks, when unloaded, with the least possible disturbance of adjacent trucks, so that loading operations going on around may not be interfered with.

For bricks, stone, and building materials the accommodation given is similar to that for coal. For dealing with this traffic many traders rent from the railway company a small piece of the yard, on which to erect lock-up sheds for their own special use.

For potatoes, vegetables, and fruit, at some of the more densely-populated centers, sheds are provided in which traders may themselves, under cover, unload their produce on to platforms raised to the level of the floor of trucks, and accessible to carts and vans.

And, wherever the fish traffic is sufficiently important, very similar accommodation is provided. But for obvious reasons this department is not allowed to be too obtrusive; on the other hand, it must be easily accessible. And, as with fruit and all "perishables," the loading and unloading must be capable of accomplishment in the shortest possible time. Small consignments of fish are conveyed by passenger trains.

For live stock, even the smallest roadside station has a short dead-ended siding, with a loading wharf alongside (raised to level of floor of truck) having easy approaches. One or two cattle-pens are erected on the wharf, and a carriage landing dock is formed at the end. Horses and carriages being often conveyed by passenger-trains, this accommodation is located near the passenger station. The cattle-pens are paved, well-drained, and supplied with water.

In all but the smallest stations there is a crane for the purpose of lifting heavy weights from the trucks directly into carts, or *vice versa*. It is usually constructed to lift five tons, and is worked by hand-power.

The general merchandise, which, as before mentioned, comprises but 28 per cent. of the total goods traffic of the United Kingdom, is

dealt with in goods sheds, and is known as "carted" or "shed,' traffic.

It is loaded and unloaded by the railway companies, which also, either by themselves or by their carting agents, perform very much of the carting in connection with it.

The bulk of this traffic is carried on at the large towns. As an instance of this, the case of the London & North Western Railway may be taken. This company has some 1,900 miles of line, which is from one-eighth to one-seventh of the total mileage in England and Wales. There are some six hundred goods stations on this company's system, but very nearly, if not quite, one-half of the general merchandise carried by the company is carried on in four towns, —London, Liverpool, Manchester, and Birmingham. These towns contain some five and three quarter millions of inhabitants, or about one-fifth of the population of England and Wales.

No doubt for economical reasons, the goods stations were originally located in the suburbs or outskirts of the large towns. But during the past twenty or twenty-five years, for the purpose of saving time and expense in carting, and in order to deal properly with the increased traffic, it has been found necessary to incur enormous expenditure in the provision of goods stations situated nearer to the business centers of the towns.

Besides this, numerous receiving houses and enquiry offices have been established in every business neighborhood. To these receiving houses (which are frequently shops erected for ordinary business purposes, but with some necessary alterations in the fittings) parcels and small goods (generally of less than five hundred pounds) are sent by the traders. These receiving houses are of very great use to the public, bringing the railway service to the door of the trader, and are most valuable adjuncts to the goods stations. They enable the railway carts, when they have finished the delivery of goods sent from the goods station, to pick up a full load for their return journey, instead of going back empty, or with only a few packages picked up from door to door.

In the recently-erected central goods stations, owing to the costliness of the sites, it has been necessary to use to the greatest advantage every square foot of the area, at the same time avoiding the mistake of cramping the working-spaces.

Hence we find that in many instances there are, over a large portion of the area, two railway yards, one carried some twenty or twenty-five feet over the other by steel or cast-iron stanchions and rivetted girders. Wherever the nature of the site permits, there are easy cart approaches to each level.

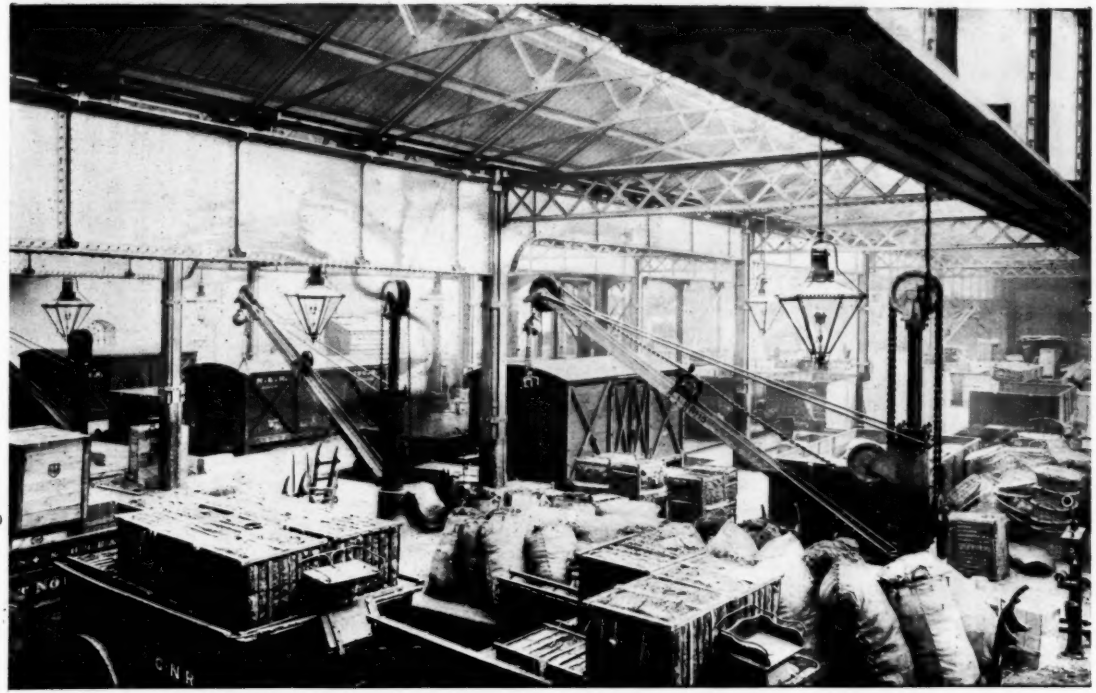
In many of the earlier examples, goods stations were constructed in brick vaults under passenger-stations. These are necessarily cramped, inconvenient, and dark. Turntables in such cases cannot be dispensed with, and consequently the access by trucks, as well as by carts, is a slow process.

But to return to the newer type. Usually the sites are so confined that one level only is accessible by locomotives. Hence hydraulic hoists are used to raise and lower the railway trucks to the other level. The tables of these hoists are about twenty-three or twenty-four feet in length, sufficiently long to take any trucks in ordinary use in England. These hoists are calculated to raise about twenty tons. The trucks in ordinary use weigh from four to five tons, and have a maximum capacity of ten tons.

GREAT NORTHERN RAILWAY COMPANY'S DEPOT AT FARRINGDON ST., LONDON.
UPPER OR STREET LEVEL.

The warehouse proper is erected in some convenient position. It has two or more floors above the higher rail-level. These warehouses are plain, substantially-built structures, with brick walls, cast-iron or rivetted-steel stancheons, and fire-proof floors. They are furnished with hydraulic hoists communicating, in the interior, with the platforms or cartways at the rail-levels, and, on the exterior, with any cartways provided.

The loading decks or platforms alongside the sidings are located immediately beneath the warehouse, so that they may be in direct communication by means of hydraulic hoists, although their chief use is as working platforms for general goods.



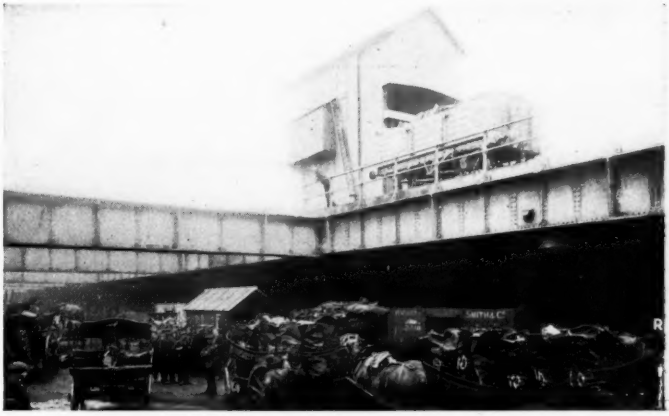
UPPER LEVEL OF THE GREAT NORTHERN RAILWAY COMPANY'S FARRINGDON STREET DEPOT, LONDON.

Being two miles nearer the heart of the city, and consequently upon land of very high value, this is naturally on a smaller scale than the Somers Town station, illustrated on pages 295-297.

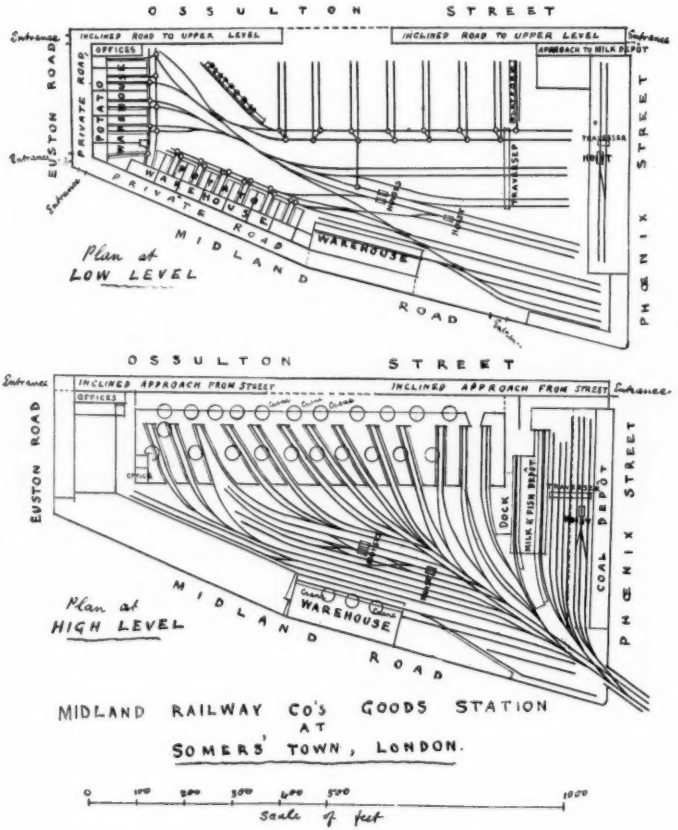
SOMERS TOWN GOODS WAREHOUSE, MIDLAND RAILWAY, LONDON.

They are commonly about twenty-four feet in width, and have a cartroad, from thirty to forty feet wide, running alongside, opposite the siding. Cranes are fixed along the center of the platforms.

But in some recent examples a series of short platforms (each from 120 to 160 feet long,—*i. e.*, for six to eight trucks) are placed in parallel lines, with a pair of sidings alongside each. The ends of these sidings and short platforms abut on to a longer and wider end platform, to which the carts are brought and backed. Cranes are



COAL PLATFORM OF THE SOMERS TOWN STATION, SHOWING HYDRAULIC HOIST.



fixed in the center of each short platform and along the outer edge of the end platform.

The end platform should be thirty feet in width, and the shorter platforms twenty feet. The cartroads should be forty feet wide, to allow of two carts passing in front of those backed against the edge of platform. The platforms are from 3½ to 4 feet in height above rails. The sidings in these central goods stations are very carefully laid out, so as to enable trucks to be brought into their places quickly. Wherever possible, in order that the whole of the shunting may be performed by locomotives, nothing but ordinary turnouts are used for connecting the sidings, but this is impracticable in

very confined sites, and turntables, traversers, and capstan-working have to be fallen back upon.

Where there are two levels of rails (upper and lower working floors), those goods which require the greater dispatch are handled at the ordinary level of the railway, and those only of the trucks which contain the less urgent consignments are sent to the hoist. Goods not intended for delivery on arrival (or "wait order" consignments) are lifted to one of the warehouse floors, and there deposited. These goods are allowed to remain there for about a month without payment, but after that period a small charge is made for warehousing.

Hydraulic capstans, cranes, and hoists are largely used, and some-

LOADING PLATFORM IN THE SOMERS TOWN STATION.

90 to 100 carts can be backed against the long main platform, and about 180 trucks can be accommodated in the 26 sidings alongside the branch platforms. Weighing machines are placed on the platform in each bay.

times traversers are worked by hydraulic power, but, beyond this, few mechanical labor-saving appliances—such as conveyors—are used in these stations.

The diagram plans on the opposite page show the general arrangement of the low and high level floors of the Midland Railway Company's goods station at Somers Town, London.

This station—which adjoins the St. Pancras passenger terminus—occupies an area of about fifteen acres. It has been built about five years, and is an excellent example of the latest English practice. It will be noticed that on the high level there is direct connection by locomotive to every siding, no turn-table—or capstan and hawser—being required for placing the trucks in their berths.

AN ENGLISH "ROADSIDE STATION." STATION BUILDINGS AND ENTRANCE TO GOODS YARD.

The station master's dwelling is in the upper storey. In more modern examples it is in a wholly detached building.

The clear height of the shed is 25 feet. The columns supporting the roof are spaced at a distance of 35 feet apart, so as but very slightly to obstruct the working space. The greater number of the hydraulic cranes fixed on the platforms will lift 30 cwt.; some few will lift 40 cwt. At this station, separate invoices are given for the contents of each truck; and for the quick conveyance of the consignment notes from the truck side to the invoice office there is a "ball railway," similar to those frequently used in large retail shops, but introduced into railway sheds for the first time at this place.

At one end of the shed there is a raised platform for carts, running alongside and at a level of about 4 feet above the rails of siding. This is to enable carts to be backed up to the trucks and discharge their goods over the top of the sides of the trucks, without lifting the goods above the level of the floor of the cart.

In other parts of the yard full cart-loads can be brought at the level of rails to the truck side, without the intervention of a platform.

As will be seen from the views, the shed is admirably lighted by day. At night it is electrically lighted so that work then can be carried on as expeditiously and as safely as by day.

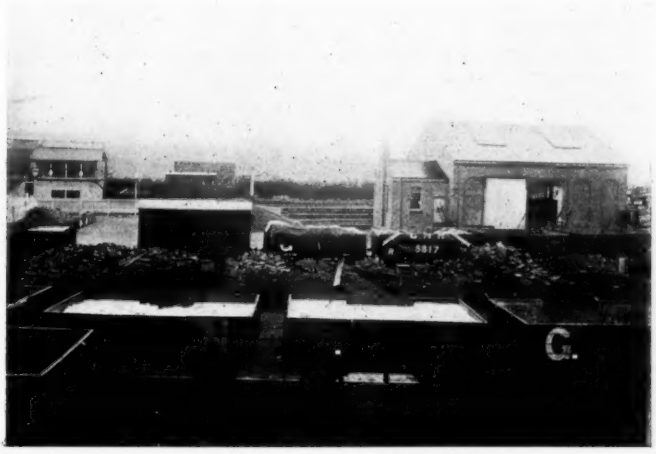
Every cart on arrival at the station is taken on to a weighbridge at the entrance to the shed. Frequently as many as 200 carts are weighed during one hour.

In this shed miscellaneous goods are unloaded, checked, weighed, distributed, loaded and dispatched at the rate of 150 tons per hour; allowing for relays of wagons, and of staff, the full capacity is estimated at 2000 tons in 24 hours; but it is only during three or four hours in the late afternoon of each day that the shed is worked to its full capacity.

There is, of course, no space available at these central stations for the sidings necessary in order to arrange and sort the outgoing trucks in proper train order. This work is done in the sorting and marshalling yards, which are a few miles outside the towns.

To these yards are brought all the trucks from and to the various local stations. A train, on arrival at the entrance to the sorting sidings, is turned into one of a group of parallel reception sidings. Here the engine is detached, and the wagons are uncoupled and put by a shunting engine into one or other of a series of sorting sidings, according to destination. Sometimes a second series of sorting sidings is laid in for the purpose of further sorting the trucks (already put into train order) in proper station order. The trucks, being thus arranged in the proper train and station order, are then ready to be taken to their destinations.

Separate sorting sidings are laid in for "arrivals" and for "departures." If the gradients of the railway, and the contour of the site are favorable, these sorting sidings are laid to a fall of 1 in 80, or 1 in 100. This falling gradient allows the sorting to be per-



AN ENGLISH ROADSIDE GOODS STATION.

SIDINGS AND GOODS SHED AT A SMALL ENGLISH STATION.

formed by gravitation. Otherwise shunting locomotives, and sometimes horses, are used.

In recent years the growth of traffic, and the acceleration of the speed of goods trains as well as passenger trains, have compelled the railway companies to expend vast sums in widening their trunk railways and in laying down many hundreds of miles of additional running lines alongside the original double road.

Thus the London & North Western Railway had, at the date of the last-published returns, 29 miles of three-line road, and 177 miles of four or more lines, against 1,306 miles of double line.

This widening of the road is always more troublesome, and often more costly, than the construction of a new railway, but it is especially difficult in passing through the stations. There the provision of additional running lines very often involves the entire re arrangement of the yards, and thus very frequently buildings are pulled down for this reason as well as for extensions and improvements (some have already been rebuilt twice). Yet, with few exceptions, the buildings erected for railway traffic—of all kinds—are solidly built. Brick walls and slate roofs are the rule, timber and galvanized corrugated iron being seldom used either for walls or for roofs.

For the diagram plans and for permission to photograph the Somers Town depôt, and also for many of the particulars herein, the writer is indebted to Mr. George H. Turner, the general manager of the Midland Railway: thanks are also due to Mr Alexander Ross, the chief engineer of the Great Northern Railway, for permission to photograph the Farringdon street depôt.

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Confidence in Safety Appliances.

THE recent accident to an elevator in one of the modern office-buildings in New York city, by which two lives were lost has caused some comment as to the general question of the reliability of the safety devices which are expected to make such casualties impossible.

We are in the habit nowadays of trusting ourselves in very many ways to the care of mechanical appliances. Not only in elevators, but on railways, in electric lighting, in building construction. and in many other lines, our lives are constantly dependent upon the prompt and absolute reliability of the automatic mechanical devices which have been thought out with great care and constructed with the best mechanical skill available.

The public confidence in the safeguards placed around the innumerable sources of danger is fully justified. In spite of the enormous increase in the number of possible mechanical dangers, the death-rate diminishes continually. When a safety appliance acts, little or no notice is taken by the public, if, indeed, the fact that it has acted is known at all, but every failure is given wide publicity.

In the case of the fall of the elevator in the Tract Society Building, of which an account is given in the *Scientific American* (September 25) and in *Engineering News* (September 23) it appears that the safety device intended to hold the car in the event of falling did act at one of the lower floors, and was then released by the engineer, who, however, left the releasing-bar in place, instead of removing it, thus preventing its action a second time That second demand upon the safety check came a few minutes later, and both engineer and elevator-boy fell from the top to the bottom of the shaft, in the car, the ropes all apparently having been ruptured by overwinding.

Such an occurrence is really no condemnation of the safety clutch, since the presence of the obstructing bar practically deprived it of existence as a safety device,

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and, under such circumstances, should cause no apprehension to passengers on other elevators. It should, however, cause still further study to be given to the subject of safety appliances from a different standpoint.

A safety check must not only work perfectly when let alone, but it should also be practically impossible for any one to tamper with it, or prevent it from working, either carelessly or intentionally. How this result can best be achieved is a matter for the elevator-designers to decide. Possibly something in the line of interlocking devices, by means of which motion of the hoisting mechanism would be prevented until the safety check was freed, may be the solution of the problem. Or a duplication or multiplication of independent checks, just as a multiplication of time-lock movements is used to prevent lockout on bank vaults, might guard against any failure of a single device. Whatever means be employed to render accidents still less probable can only increase a confidence which is even now not misplaced, for the conditions under which the recent disaster occurred are most unlikely to be repeated.

Electric Traction on Elevated Roads.

THERE has been much discussion at various times as to the feasibility of substituting electricity for steam on elevated roads for municipal service, while at the same time the data from which definite information must be deduced have been lamentably scarce. We now have a most valuable contribution to our stock of working information on the subject in the shape of a paper read before the American Institute of Electrical Engineers at its recent convention by Mr. M. H. Gerry, Jr., and published in the *Railroad Gazette* (Sept. 24). Mr. Gerry's paper deals with the facts brought out in the operation of the Metropolitan Elevated in Chicago during the past year, and is thus based upon an exceptionally heavy and important traffic under very trying conditions.

In a service of this sort the frequency of the stops and the inequality of speed render the performance scarcely comparable with ordinary railroad duty. There is no opportunity for maintaining the speed, as the distance between stations averages only about two thousand feet, and the running time depends almost entirely upon the rate of accelerating and retarding the train. The traffic is also very irregular, being heavy at certain hours, and apt to increase and decrease at a rapid rate.

This irregularity is well shown by the diagrams of load-curves for the different days of the week, while a very interesting series of speed- and current-consumption-curves shows the effect of the frequent stops. The load-curves form a very sensitive index of the traffic, unusual increase of travel from any cause being noticed at once in the power-house. It is interesting to note that this is due not so much to the increased weight of passengers as to the longer stops, which demand a higher speed to keep the trains on time. The actual weight of paying load carried bears so small a proportion to the dead load that any moderate variation is in itself scarcely appreciable.

The following averages from a tabulated statement of a number of tests made on trains of the Metropolitan Elevated Road serve to indicate the efficiency of electric traction under such conditions. For trains of three cars on runs of 28 minutes, of which less than 2 minutes was consumed by stops, an average speed of 13.8 miles per hour was attained, including stops; or 14.1 miles, not including stops. The average current, including stops, was 122 amperes, or, not including stops, 129 amperes, and the average voltage at train was 512 volts. The efficiency from the generators to the car-axles was 50.8 per cent.; the kilowatt-hours per car-mile at train was 1.47, and at the station 1.57.

Electrical energy can be produced at Chicago with cheap coal at less than half a cent per kilowatt-hour; or, with an efficiency of 50 per cent., the mechanical energy at the car-axles is about one cent per kilowatt-hour, from which comparisons with steam locomotives can readily be made. Mr. Gerry wisely adds that mere economy in motive power is not the only

feature to be considered and that the greater flexibility and simplicity of electric over steam traction add to the commercial advantages. He favors the third-rail system whenever available, believing that for roads operating their own right of way there is no serious objection to its use, while the experience already gained justifies the statement that a reliable overhead or conduit system for heavy service can be constructed, if the conditions favor the use of such methods.

Powdered Fuel.

RECENT trials in New York of the Wegener system of burning powdered coal under steam boilers are discussed in *Engineering News* (September 16), together with some account of the successful tests of the method in Germany, France, Switzerland, and elsewhere. The principle of the Wegener apparatus is not apparently different from that of various former attempts to burn coal in powdered form, and the use of finely-pulverized coal intimately mingled with air and delivered into the furnace with or without forced draft has been attempted many times since the experiments of Crampton nearly thirty years ago.

There is no doubt that coal can be thoroughly and economically burned in this way, and that, when the fuel is reduced to a fine powder and thoroughly mixed with the air, little or no smoke is produced in the combustion. The chief impediment to the practical application of the system lies in the inconvenience and expense of grinding the coal. It is admitted that the cost of grinding the fuel to such a fineness as will enable it to pass a sieve of 125 meshes to the inch will be 10 per cent. of the cost of the coal, which in itself is worth considering.

So far as comparative economy is concerned, powdered fuel shows about as good results as are obtained with other first-class mechanical stokers, giving evaporations of 9 to 11 pounds of water per pound of coal (no allowance for ash) and 70 to 75 per cent. in boiler-efficiency; but, as these results are charged with the cost of powdering the coal, it is questionable whether there is any real advantage. The comparative tests made in Europe were with furnaces which showed only 55 to 60 per cent. in boiler-efficiency with hand-firing, and hence can hardly be considered applicable for determining the relative value of the Wegener system as compared with automatic stokers; and even hand firing, with skilled firemen and careful regulation, will give results which approximate 70 per cent. in efficiency.

When, as is suggested by *Engineering News*, the Wegener furnace is compared with other improved methods of burning bituminous coals,—down-draft, under-feed, etc.,—in fire-brick furnaces, one cannot doubt that results fully equal to those obtained by the use of powdered coal may be secured without spending, for grinding, 10 per cent. of the cost of the coal, besides paying costs of installation, royalty, and maintenance.

The Bakersfield Transmission.

AN interesting feature of the hydraulic and electric power plant at Bakersfield, Cal., in which 2,500 h. p. of the Kern river is utilized, and which is fully illustrated and described in the *Journal of Electricity* (August, 1897), is that practically all of the power is to be used in pumping water for irrigation purposes. The Kern river itself does not supply sufficient water to irrigate the thousands of acres directly, but what it lacks in volume it makes up in energy. Kern county is underlaid with ground water about twenty to thirty feet below the surface, and, by converting the energy of the river into electricity, transmitting about twenty-five miles, and using it to operate centrifugal pumps, sufficient water may be pumped to the surface to irrigate the land effectively.

The plant thus offers an example of transformation of water not dissimilar to electrical transformation, in that a moderate volume at high pressure is transformed into a large volume at low pressure, and the intervention of the turbines, generators, and electrical transmission forms an intermediate detail of this unique installation.

Mechanical Excavating Devices.

AMONG the important and interesting papers presented before the recent meeting of the American Institute of Mining Engineers at Chicago, that of Mr. J. F. Lewis upon the Chicago Main Drainage Canal possesses especial value as illustrating the advances which have been made in machinery for excavating and handling earth, rock, and similar material. In fact, apart from a discussion of the geological features of the work, Mr. Lewis's paper is chiefly devoted to an account of apparatus either modified, or especially invented and constructed, for the purpose of replacing older and slower methods. In several instances contractors found it impossible to perform the work at the contract prices, except at serious loss, when using the ordinary steam-shovel and car plant, while new contractors, by installing modern conveyors, steel belt excavators, and other special appliances, were able to make money at even lower prices.

This was notably the case with the more difficult portions of the excavating. In one case the first contractors for one of the sections removed some 70,000 cubic yards of cemented boulder-clay at a cost of 69 cents per cubic yard, when their bid was only 27½ cents. They then gave up the undertaking, whereupon the contract was re-let to others, who, with improved incline and tipple plants, were able to do the work successfully for 27 cents per cubic yard.

In another instance contractors paid the builders of the Brown Cantilever apparatus 15 cents per cubic yard for conveying rock from the pit to the dump, when experience developed that the actual cost, including labor, fuel, oil, waste, and repairs, amounted to only 2 cents per cubic yard.

The apparatus used on various sections of the canal included inclines and tipples, bridge conveyors, cantilevers, steel belt conveyors, and traveling cableways, together with powerful steam excavators and revolving derricks, all of which are illustrated from photographs in Mr. Lewis's paper, together with maps, sections and diagrams relating to the work in general. The work is an excellent example of the development of special means to attain a special end, and the results accomplished by the improved devices used upon the Chicago Drainage Canal should cause a revision in the methods of estimating the cost of similar work.

The Strength of Bins.

THE recent failure of a large coal-bin, and the consequent stoppage for a time of the Paterson electric power station, has caused some discussion as to the actual behavior of granular materials when stored in bulk, as well as the proper method of computing the strains upon the bins.

The Paterson failure is very fully discussed in *Engineering News* (September 23), both from the builder's standpoint, and in an editorial dealing with theoretical principles, and, while the immediate cause of the accident does not yet clearly appear, some interesting points are brought out. The economy in handling which is obtained by dumping the coal in bulk into bins, from which it can be fed to the boilers direct, has led to the very general adoption of this arrangement in the numerous power houses and large steam plants of recent erection, and the location of these overhead bins is necessarily such that in most cases the consequences of failure would be most serious, possibly including loss of life.

The importance of providing a large margin of safety, both by correctness of design and excellence of material and workmanship, should be always considered under such circumstances, and, in view of the limited amount of information accessible, the present discussion is not without value.

It is the general practice to consider granular materials—coal, sand, grain, and the like—as exerting a lateral pressure depending upon the angle of repose assumed by the material when piled freely in an open space. Theoretically this seems reasonable, but it is not always wise to assume that the lateral pressure thus deduced is the greatest that can come upon the walls of the bin. The internal friction of a granular mass is not necessa-

rily constant, and it is by no means impossible that the withdrawal of coal from below might set up a motion within the mass which would produce much greater stresses than those theoretically assumed; while temporary obstructions to flow, when suddenly overcome, would add the influence of impact. Our contemporary is decidedly on the safer side in recommending that the mass be considered, for purposes of computation, as acting like a liquid, and the center of pressure be assumed as at the point corresponding to liquid pressure, rather than at the point where a line through the center of gravity of a solid would fall.

Under such assumptions a bin should be computed just as if it were to be a tank for water, taking into account the specific gravity of the substance to be stored. When with these assumptions a designer shall take a sufficiently low fiber stress to provide ample margin of safety, such as the serious consequences of failure demand, he will have taken only reasonable precautions against disaster.

The Extension of the Niagara Power Plant.

So much has been written about the Niagara power plant that the subject seems almost threadbare, but the paper recently read before the Engineers' Club of Philadelphia by Mr. Chas. F. Scott, and published in the *Transactions* (July–Sept.), gives some very interesting information about the practical performance of the plant during the past two years of its operation, as well as the extension of capacity now being made.

The original installation involved both electrical and mechanical units so much larger than had previously been made that there was room for much difference of opinion as to the details of construction to be adopted, and, with every care and precaution possible, it was yet admitted that there were many elements of experiment in the apparatus.

Prior to the construction of the works at Niagara no turbine of 5,000 h. p. had ever been built by any manufacturer, and even in Switzerland Messrs. Faesch & Piccard, by whom the turbines were designed, had previously made nothing larger than a turbine of 700 h. p. With this problem was involved the transmission of 5,000 h. p. through 140 feet of vertical shafting, including the supporting and counterbalancing of the great weight in motion; while above all came the generator to convert this unprecedentedly large hydraulic unit into electrical energy.

Three such units were successfully installed, and have been in satisfactory operation for more than two years, and the most emphatic approval that can be given to the original plans is found in the fact that they are now practically to be repeated in the extension of the plant. To quote from Dr. Coleman Sellers's remarks upon Mr. Scott's paper: "At the present time the wheel pit and power-house at Niagara Falls are being extended, and new machinery is well under way. Five units, each of 5,000 h. p., will be added to the three now in operation. The extension of the machinery is in harmony with the present plant, which was considered experimental by most engineers. A careful study of the operation of the turbines and of the dynamos has enabled improvements to be made in the direction of simplicity and increased durability. The efficiency promised by the makers of the existing plant was deemed by many engineers as problematical. For the new machinery a higher efficiency is guaranteed, and I have confidence in the result. The new dynamos will not differ in outward appearance from those in use, the changes being mainly in the armature for the diminution of copper and iron losses, and more perfect ventilation."

With these slight modifications, then, the work of the designers of the original plant is to be repeated in the extension, to the undoubted credit of all concerned. In this respect Dr. Sellers himself is especially to be congratulated, since the work has been under his skilful direction from the start.

In addition to its very clear and interesting description of the existing plant, Mr. Scott's paper brings out the fact that a large portion of the energy utilized at Niagara is employed in industrial opera-

tions which are the direct outcome of the new source of power. The electrolytic reduction of aluminum, and of metallic sodium, the production of carbids of silicon (carborundum) and of calcium, with other electro-chemical industries, use much of the chemical and thermal energy of the current, and these are dependent for their commercial existence upon the presence of abundant power at moderate price. As Mr. Scott concludes: "The important enterprises at Niagara are new. The processes are among those which electricity has so recently given to the arts. They are large consumers of power, and their commercial practicability depends upon its cheapness. In ordinary manufacturing industries the cost of power is a small percentage of the cost of material and labor, and the power is used only a small part of the day. In the industries at Niagara, the cost of power is the vital element, and, while, on the one hand, their continuous operation makes them ideal customers of a water-power plant, on the other hand, they are significant omens of the advance in the industrial methods which is made possible by abundant and cheap power."

The Great Falls Power Plant.

HYDRAULIC power has exhibited an unprecedented development in the past few years, in connection both with long-distance transmission and with immediate use in local industries. Among the latest plants completed in the United States, that at Great Falls, Montana, is of especial interest, not only because of its magnitude and constructive importance, but also because the current is principally to be used in the electrolytic reduction of copper. Between 40 and 50 feet head of water is available at Great Falls, and this is utilized to develop 2,800 h. p. by what is claimed to be the largest and most powerful pair of horizontal turbines ever built for such a head.

From an account of the plant given in the *Scientific American* (September 25) the following points of interest are given. The two turbines, each 57 inches in diameter, are placed horizontally at the ends of a cast-iron draught chest, and discharge centrally through a plate-iron draught tube 10 feet in diameter. The turbines and draught chest are inclosed within a huge cylindrical flume 14 feet 4 inches in diameter and 32 feet 6 inches long, built of ½-inch steel, the ends being closed by cast-iron covers with stuffing-boxes for the shaft, the turbines and draught chest being thus entirely inclosed. The water entering the flume passes through both wheels in opposite directions, thus neutralizing all axial pressure, and flows down and out through the draught tube. The wheels are carried on a 10-inch shaft, to which at each end is coupled a 1,000-h. p. Westinghouse electric generator, while power is also taken off by belting for two 50-h. p. exciters as well as an arc-lighting dynamo. Test of these wheels at Holyoke showed the excellent efficiency of 81¼ per cent., at three quarters to whole gate, and the whole installation, while containing nothing radically new, reflects much credit upon the builders, the Dayton Globe Iron Works, for the magnitude and successful performance of the plant.

The Precision of Electrical Engineering.

UNDER the above title Dr. Francis B. Crocker presents his inaugural address as president of the American Institute of Electrical Engineers, published in *Electricity* (September 8), and takes occasion to refute the too-widely-spread idea "that electricity is so imperfectly understood that its laws and actions are little more than matters of chance or guesswork."

The claim is made that electrical engineering, far from being an inexact or crude science, is more precise than many older branches of engineering. In maintenance oft hese claims, Dr. Crocker cites a number of points. After calling attention to the list of great names of distinguished men noted for their devotion to the exact sciences and inseparably connected with the development of electrical science, he points to the rapid progress and great results accomplished, as proofs of the precise nature of the knowledge possessed of the laws governing the application of electricity. So certain or rapid progress could not have been made by

blindly groping with cut-and-try methods; uncertainty would necessarily have caused delay, and error would have involved repeated trials. "The fact that the difficult arts of long-distance transmission of power, and electric traction, have been developed to their present state of importance and success in about ten years shows conclusively that electrical theories and designs agree very closely with the actual facts."

Again, the close relationship between pure and applied electrical science is given as proof of the exactness and truth of both, and numerous examples may be given showing the agreement between computed values and experimental determinations. Instances of this agreement between electrical theory and fact are found in the development of the theory of electro-magnetism by Ampere within a few days after its discovery by Oersted, and in the close corroboration of Maxwell's theories by subsequent investigations. Another point distinctly bearing upon the claim for precision in electrical science is the exactness in electrical units and terms. In this respect electrical science certainly possesses a great advantage over older branches, the system being not only definite and precise, but also international, and accepted all over the world.

The accuracy of electrical measurements, and the facility with which they are made, also contribute greatly to the precision of electrical engineering, the methods of exact science being thus brought into the daily practice of the electrician to a greater extent than in almost any other branch of applied science.

As a single example of the precise results attained in electrical work, Dr. Crocker cites the location of faults in ocean cables. In the case of a cable thirty miles long coiled in a tank a fault in the gutta-percha has been determined to within a probable error representing about twenty feet of length. In ocean cables the average error in practice is about a mile and a half, and under favorable circumstances much less.

In designing generators, the efficiency can be predetermined from the drawings, before the machine is built, within a fraction of 1 per cent. and it is sometimes questioned whether the probable error in testing the completed dynamo is not greater than that of the preliminary computation. A tacit admission of the greater accuracy with which electrical measurements can be made, as compared with those of other forms of energy, is found in the fact that, when it is desired to test the amount of power required in any given case, the quickest, neatest, and most mechanical method is the use of an electric motor. In this way tests of the lubricating values of oils have been made, as well as the power consumed by fans, pumps, or other machines.

The Melan Arch in America.

A NOTE in *Engineering News* (Sept. 23) upon the progress of the Melan Arch bridge now under construction at Topeka, Kan., is of interest as calling attention to the value of this combination of steel and concrete.

In Europe the use of metal and concrete has become frequent. The Monier system was originally devised to introduce metal merely to sustain tension, and thus enable an arch to resist forces which otherwise would cause rupture of masonry. Prof. Melan went further than this, and practically substituted light steel girders for the skeleton of the arch, these being imbedded entirely in a mass of concrete.

The principle has been carried still further in one of the designs for the proposed bridge at Berne in Switzerland, in which an arch of two hundred and forty feet span is designed with an internal structure of steel lattice-work, the whole being encased in concrete, so as to resemble, when completed, an arch entirely composed of masonry.

The excellent results obtained with the Monier arch of seventy-five feet span, tested at Vienna, should encourage American engineers to a more general use of these methods of combined metal and concrete construction, the advantages being on the side of both economy and security.

Asphalt Pavements.

ASPHALT, as a material for street-paving, is coming more and more into use, but the opportunities for obtaining reliable information upon the subject have been very limited; hence the paper of Mr. George W. Tillson, presented before the American Society of Civil Engineers, and printed in *Engineering News* (September 2), is a welcome addition to the literature of municipal engineering.

The industry, which was still in its infancy in 1880, has assumed vast proportions, there being in the United States alone, as nearly as could be ascertained on January 1, 1897, nearly 27,500,000 square yards of asphalt pavement, to which the present year will make large additions.

Mr. Tillson gives an interesting account of the methods employed in procuring the crude asphalt from the various localities in which it occurs, and also describes the so-called refining processes, which practically consist in heating the crude material long enough to drive off all the contained moisture and remove the volatile oils. The solid matter settles to the bottom, and the refined material, constituting about 60 to 70 per cent. of the crude asphalt, is drawn off for use.

In the present state of our knowledge but little can be learned about the value of a sample of asphalt by chemical analysis. To quote from Mr. Tillson's paper:

"Whether an asphalt will or will not make a good pavement can only be told by trying. A chemist can analyze an asphalt, tell what are its component parts, and give his idea as to what it ought to do, but the author doubts if any one would be willing to give a definite opinion as to its action in a pavement simply from a laboratory analysis. Personally the author would hesitate before giving a final judgment on a pavement that had not passed through at least two winters. An analysis of the refined asphalt is required to ascertain the quantity and quality of the bitumen contained. Then, by former experience with other asphalts, and many experiments, the quantity of flux is determined, taking into consideration the climate and the amount of traffic."

Strictly speaking, the asphalt does not form the pavement proper, but is only a surfacing, and, as Mr. Tillson well remarks, "the foundation is the important part of an asphalt pavement. The surface coat is only the carpet; the base must be the floor that sustains the load. No matter how good the top may be, a failure in the base means the immediate failure in the pavement."

The best foundation is made of hydraulic cement concrete of thickness varying with the traffic, but never less than six inches. Between this and the surfacing is placed the so-called "binder" of clean broken stone, cemented together with asphaltic cement, no more cement being used than is absolutely necessary to bind the stone together. This binder counteracts the tendency of the surfacing to creep on the foundation, and unites the whole firmly together, and, when the work is well done, grades of seven to eight per cent. can be successfully used.

It is a general impression that asphalt is slippery, and this has been urged as an objection to it as a paving material. The source of slipperiness is the presence of dirt upon the smooth asphalt surface; when the pavement is kept thoroughly clean, either by washing or otherwise, little trouble is experienced.

A Correction.

BY an unfortunate confusion, the illustration of the Cunard Royal Mail Steamship Russia, appearing in the September issue of THE ENGINEERING MAGAZINE (Vol. XIII, page 910), was underlined with the statement that the vessel was lost off the coast of New Jersey.

Probably the extraordinarily successful and widely-known record of the Cunard Steamship Company furnishes a sufficient correction to most of our readers; but it is due to all to state that the Russia, after many years of excellent service in the Cunard line, was sold to other owners, and, so far as obtainable information goes, may still be in use.

THE BRITISH PRESS

Refuse Destructors.

AMONG the various methods of disposing of household refuse and garbage the use of destructors or incinerators has often been suggested; and of late, notably in the much-discussed plant at Shoreditch, the heat produced by the operation has been utilized for the generation of steam.

A refuse destructor, in order to be entirely satisfactory, must, above all things, be absolutely effective and inoffensive, and one of the greatest difficulties encountered in the installation of incinerating plants is the supposedly offensive nature of the operation, causing strong opposition from every one in the vicinity of the proposed location. In order to insure a thorough combustion, and entire conversion of all organic matter, it is advisable to use an independent heating furnace, fed with coal or coke, both to furnish the initial high temperature needed to start the combustion of the refuse, and also to maintain a higher degree of heat than could be attained by the burning of the refuse alone. The higher original cost of incineration by this method is more than compensated for by the completeness of the combustion, and a large portion of the value is recovered in the steam-generating plant, when such is used.

A refuse destructor on this principle has been constructed at Lewisham, and is illustrated and described in the *Engineer* (September 17). It is said to work very satisfactorily. The incineration is effected in an inclined revolving cylinder twenty-six feet long and seven feet in diameter, made of iron and lined with fire-brick. The furnace delivers its gases into the higher end of this cylinder, and heats the fire-brick red-hot, after which the refuse is gradually fed in while the cylinder is revolved. The intense heat of the fire-brick at once starts the incineration, while all fumes from putrescent organic matter are fully consumed during the passage through the cylinder. The angle of inclination is such that the rotation causes all solid matter to move forward, and ultimately to be deposited in a char pit, while the gaseous products of combustion pass on through a horizontal flue to a water-tube boiler, and thence to a chimney, 121 feet high.

The Willoughby destructor, as installed at Lewisham, is not yet complete, in that no steam-generating plant has been placed in the flue; for the present a water-spray is used to cool the discharged gases, which otherwise would reach the chimney at a temperature of about 2,000° F.

In its present arrangement the Lewisham destructor incinerates 72 tons in 24 hours, about 30 per cent. consisting of solid residual, such as dust, breeze, chards, tin, glass, etc. The dust and breeze is sold, and the total net cost, including fuel and labor, amounts to about one shilling per ton, of which one-third is for fuel.

As the heat is not yet utilized, the return from steam generated is not included in the above cost, and it is impossible to state just what economy will be effected by the addition of a steam plant, but there is little doubt that a combination of destructor and electric or power plant could be made a paying investment.

The Sanitary Congress at Leeds.

THE Sanitary Institute in recent session at Leeds dealt with some important subjects pertaining to health and comfort, and of reports in the *Builder* (September 18) and the *Architect and Contract Reporter* (September 17) we make abstracts.

In his presidential address, Dr. Farquharson dealt with the importance of man's physical condition as a requisite to the progress of the race, and the part which sanitation necessarily plays in human progress. The diminution of the death-rate, however, should not be taken as a proportional index to the rate of sanitary advance, since the reduction in the rate must necessarily proceed more and more slowly,

gradually approaching a probable minimum of 14 to 15 in the thousand, the mutual elements of decay inherent in mankind hardly permitting a lower figure to be reached.

Among the points bearing more directly upon the technical side of sanitation the value of light may be mentioned. When natural light cannot be obtained, even its imitations are useful, and Sir W. Preece found that in a department of the London post office the introduction of electric light diminished the sick absence by two days per annum.

The strong points made by Dr. Farquharson were, firstly, "drastic radical legislation by which the local bodies may be able to acquire land compulsorily, on paying full compensation, for building workmen's houses; and then quick and cheap railway traveling, rendering it possible for city workmen to live in the surrounding country."

The seemingly endless discussion upon the subject of smoke-abatement received its due share of attention at the congress, and some good points were brought out. Much of the excessive smoke-production is due to the forcing of inadequate boilers. "A great many manufacturers try to make a set of boilers do far more work than they are able to, to the detriment of the atmosphere." In Leeds, however, and probably in most cities where soft coal is generally burned, the manufacturers are by no means the greatest offenders. Statistics were furnished to prove that on Sundays, when the factory chimneys are quiescent, the impurities in the air are only twenty-five per cent. less than on week-days, thus showing to what an extent domestic fires were responsible for the smoke nuisance.

In discussing the question of ventilation, its close relation to warming was made apparent; indeed, it is impossible, in cold climates at least, to consider the one without taking the other into account. Many buildings also, especially those in which many work-people are engaged, cannot be properly ventilated under existing conditions without producing continuous draughts.

Oil-Fired Locomotives.

NOTWITHSTANDING the fact that a careful investigation of the subject of oil-firing for locomotives by some of the leading railroad companies of the United States has resulted in negative recommendations, the use of oil fuel has continued to find favor on the roads tributary to the Russian oil fields, and is also extending in England.

The Cromer express, on the Great Eastern Railway, is claimed to make the longest and fastest continuous run made by any oil-fired engine now running, and an account of the trip, given by a correspondent in the London *Engineer* (September 17), contains data about the practical side of oil-firing which are worthy of record.

The engine is a simple, single-driver locomotive of 42 tons weight, with cylinders 18 by 24 inches, and 7-foot drivers. The boiler has 1,217 square feet of heating surface, and 18 square feet of grate, and carries a steam pressure of 160 pounds.

The length of run, from Liverpool street to Cromer, is 130 miles, which is made in 160 minutes with one stop about eight miles from Cromer, making the excellent average speed of 48.75 miles per hour, with a train weight of not less than 180 tons, and frequently more.

The firing is done on the Holden system, the oil being sprayed over a bed of coal and broken fire brick upon the grate, the coal being necessary only to furnish an incandescent bed to receive the oil at starting. During the run the coal is gradually consumed, but the fire-brick, which is uniformly distributed over the grate, becomes incandescent, and not only serves to maintain the combustion of the liquid fuel, but also acts as a medium of radiant heat to the firebox surfaces of the boiler.

Notwithstanding the fact that grades as stiff as 1 in 100 occur on a portion of the line, the schedule time is well maintained, the speed reaching a maximum of 54.4 miles an hour for a stretch of 31¾ miles, and being limited through certain sections to from 30 to 35 miles.

The actual quantity of oil consumed is approximately 180 gallons, varying some-

what with the load and the weather, and the ease of firing and prompt control of pressure obtained with the liquid fuel are greater than would be possible with coal-firing. For an ordinary coal-fired engine to accomplish this service, it is estimated that about 2¼ tons of coal would have to be shoveled into the firebox for each trip. As the train has been running regularly with oil-firing during the past summer, the data thus obtained are much more useful for practical purposes than figures obtained by special tests covering but a limited period.

Armor-Piercing Projectiles.

THE success which has attended the new Hadfield projectiles in piercing Harveyized armor plate is the cause of some congratulation in British military circles, and not without reason, since until very recently the main dependence for armor-piercing projectiles was placed upon the Holtzer manufacturers.

In commenting upon this anomalous state of affairs, *The Engineer*, in the issue of September 10, speaks very plainly of English neglect to encourage the manufacture of armor-piercing shot, Hadfield being obliged to push on with his numerous experiments under much discouragement.

His labors appear now, however, to have attained material success, as the following account of the recent trials shows: "Two 6-inch Hadfield projectiles, of special design and quality, and with caps on their points, were fired with a velocity of 1,960 feet and 1,940 feet per second at a large Harveyed steel plate, 8 feet square and 6 inches in thickness. The plate on its upper surface had before received two 6-inch forged steel shots, neither of which had penetrated more than about 2¼ inches. There remained about 70 per cent. of the plate area untouched and uninjured. In both cases the projectiles pierced the 6-inch plate and 2 feet of wood backing, and were found 15 feet to 20 feet at the rear, in the sand butt. Though broken, the wreckage and destruction of timber, bolts, and fastenings, caused by the projectiles, were especially great, showing the considerable remaining energy they possessed after passing through the plate itself. If this had been on a ship's side, the damage done would have been very serious, the broken portions, not one of which was found on the front side, acting as *mitraille*, as was proved by the shattered condition of the surroundings and the backing."

The good quality of the plate is demonstrated both by the fact that the previously-fired forged-steel shots penetrated only 2½ inches, and by the shattered condition of the Hadfield projectiles after the piercing. In view of the details given, it must be admitted that Mr. Hadfield has proved his ability to make a projectile decidedly superior to any yet tried against modern armor.

It is to be hoped that some of these new projectiles may be used in armor-plate trials in the United States also, in order that the severest test may be applied under well-ascertained conditions.

The Preservation of Iron in Buildings.

IN the issue of the *Builder* for September 11 is an article by Mr. H. C. Standage, discussing the effect of various paints and other preservatives of iron work used in building. Mr. Standage emphasizes the injurious effect of many so-called preservatives, which are themselves the first to start the conversion of the iron into oxid by the liberation of glycerine from the linseed oil used as a vehicle for the pigment. When the oil enters into chemical combination with the pigment, the glycerine is set free, and promptly absorbs moisture from the atmosphere, setting up erosion and beginning the destructive work of converting the metallic iron into rust.

The true theory on which the composition of preservative paints should be based then, according to Mr. Standage, is that of the absorption of the glycerine by some of the constituents. It is on this theory that he finds the reason for the admitted superiority, as preservatives, of paints containing either red oxid of iron (Venetian or Indian red) or red oxid of lead. Red oxid of iron combines to a great extent, and red oxid of lead completely, with the glycerine eliminated from

the linseed oil, thus rendering it nearly or entirely harmless. In the case of red oxid of iron the action of the glycerine upon the metal does go on slowly, beneath the hard and dry exterior coating of the paint, and hence this cannot be considered a perfect preservative. Mr. Standage maintains that the only pigment which absorbs all the glycerine—the cause of all the mischief—is red lead. He also gives directions as to the preparation of a mixture for the purpose of toughening the red-lead coating, and adding to the strength of the film; but the fundamental principle is that above described. The presence of glycerine in paint has not been generally considered.

The Action of Fire on Structural Steel.

IN the course of a series of papers on "Fire-Prevention in Europe," Mr. Edwin O. Sachs gives in *Engineering* (September 24) some striking examples of the superior resisting power to fire possessed by timber construction as compared with structural steel or with cast iron. These examples are taken from the collections of photographs kept by the fire departments of Hamburg and of Bremen, and show very clearly the manner in which steel and iron yield and buckle when exposed to conflagrations which at the same time only char the surface of wooden posts and beams without causing failure.

The necessity of protecting structural steel work from the direct action of fire is well understood at the present time, and in buildings of recent erection, with reasonable claims to fire-resisting qualities, no unprotected beams or columns are permitted; but Germany is not the only country in which warehouses filled with combustible merchandise have been constructed within recent years, and are still in use, containing unprotected latticed columns, exposed beams, and corrugated iron surfaces.

The photographs published by Mr. Sachs, showing an utter lack of resisting power in buildings in extensive use, are far more instructive than whole treatises on fire-proof construction; and it is to be wished that collections of similar photographs were more generally available for reference by architects and builders.

Referring to the practice in Germany, Mr. Sachs says: "Photographs of this department are prepared of any important detail of construction which has had to withstand fire; also small folios with these photographs, to which are added particulars of the conflagration, information as to the construction, and frequently plans of the buildings involved. The movement for improved fire-prevention owes much to small labors of this kind, and, if more was done in this way, our architects and engineers would be better able to see the effects of fire on materials and on methods of construction generally than has been the case at present with improved tests or experiments."

There are doubtless many important photographs and records of the failure or success of various forms of construction to resist fire, but these are not always available for professional reference when most needed; nor is the accompanying information to be had. The American Society of Mechanical Engineers has at the present time an earnest and efficient committee at work, investigating the action of fire upon different forms of construction, and some valuable partial reports have been made; but, apart from this experimental work, a methodical record of actual performance would constitute an invaluable guide for future practice.

The Building of the Oceanic.

NOW that the *Kaiser Wilhelm der Grosse* has become an accomplished fact, attention is directed toward the next and still greater ocean-liner, the Oceanic, of which details are given in the *Engineer* (September 17).

The keel of the Oceanic was laid at the Belfast yards of Messrs. Harland & Wolff in February last, and the launch is expected next January, a remarkably short time for so enormous a hull; for it must be remembered that the length, 704 feet, is 2⅝ feet greater than that of the Great Eastern, and 65 feet greater than that of any other ship, either afloat or in course of construction. The great size of the

Oceanic, as well as the short time in which her completion is being attempted, have involved the adoption of various unusual expedients, some of which are of sufficient interest to warrant description here; therefore, from the columns of the *Engineer*, we give the leading features of the methods adopted by the builders.

In order to provide room for the unusual length of the vessel, it was found necessary to extend the building berth far beyond and below high-water mark, by forming an immense coffer dam of heavy sheet piling around the extreme end of the berth and inwards along the sides to some considerable distance beyond high-water mark. By closing this coffer dam at low water, and keeping it clear of leakage by pumping, work has proceeded on the aft end of the ship continuously, regardless of the tide. While this adaptation of a coffer dam is not new, it is here used on a very large scale.

The rapid handling of materials in the construction of the Oceanic is being accomplished by a special arrangement of overhead traveling crane. For the support of the crane low walls of concrete have been built, clear of the ship's side and extending the entire length of the hull, and upon these walls tracks are placed, carrying a gantry which spans the whole width of the ship well above the height of the uppermost deck. The gantry is provided with hydraulic gear for longitudinal and transverse travel, as well as for hoisting, and will thus cover the entire area occupied by the vessel in the same manner as a modern power traveling crane covers the floor of a machine-shop or foundry.

This crane will be used, not only for the handling of materials of construction, but for the support and control of numerous portable power tools for drilling, riveting, and similar work. By the use of these and other mechanical appliances the work upon the great ship will be carried on at a much more rapid rate than would be otherwise possible, and the extensive use of power tools should also add to the high quality of the workmanship.

While the Oceanic is intended as a record-breaker in point of size, and also in coal endurance, no claims are being made for extraordinary speed. She is not intended to steam at twenty-seven knots, as has been reported, but is expected to have a sea speed of twenty-one knots,—one knot in excess of the Teutonic and Majestic, while for stanchness, safety, and luxury she is expected to surpass all predecessors.

The question of coal endurance has been considered, in view of the possibilities of the vessel as an armed cruiser, or as a transport ship for troops, and at a rate of twelve knots she will be able to steam 23,400 nautical miles, or practically the entire circumference of the globe, without coaling.

A Pumping-Engine Test.

THE *Engineer* of September 24 contains in full the report of a test of a pair of Worthington triple-expansion pumping engines, made by Simpson & Co., for the West Middlesex Water Works, and tested recently by Prof. W. C. Unwin.

The test makes a remarkably good showing for the engines, but our principal reason for referring to it here is rather to comment upon the admirable character of the test.

The engines are a pair of vertical, direct-acting beam pumping engines, with Worthington "high-duty" equalizing cylinders, the high- and intermediate-pressure cylinders being placed tandem over one end of the beam, and the low-pressure cylinder over the other, with direct connections to the pumps below. This arrangement was governed largely by the fact that the engines are placed in an old engine house designed for Cornish Bull engines, limiting the form and dimensions of the available space.

The dimensions of each engine are as follows: cylinders, 18½×29×45 inches bore; normal stroke, 60 inches. A speed of about 20 double strokes per minute was attained. Steam was supplied by two double-flued Lancashire boilers 7 feet 6 inches in diameter and 28 feet long, at a pressure of about 112 pounds absolute. For details of the test reference should be made to the original report. We may

say, however, that the absolute thermal efficiency of the engines was a little more than 14 per cent., the duty per 100 pounds of coal about 116,000,000, and the coal-consumption 1.53 pounds per i. h. p., not allowing for about 5 per cent. of ash.

In order to investigate the full effect of all the forces, Prof. Unwin desired to take into account the action of the inertia of the moving parts of the machinery. This has frequently been done in most varieties of engines with crank and fly-wheel connection, in which the law of variation of piston-velocity can be assigned; but, until now, the effect of the inertia of the moving parts of a Worthington engine has not been investigated, the variation in velocity not being governed by determinate mechanism.

It was therefore necessary to construct a special apparatus for the determination of the velocity of the moving parts at various points of the stroke, and the purpose was ingeniously served by means of a pencil attachment connected to the piston-rod and describing a curve on a sheet of paper kept moving at a uniform rate. The vertical ordinate of the curve described represented the actual piston movement, while the horizontal abscissa was proportional to the time from the beginning of the stroke. From these data it was possible to construct an inertia curve, knowing the weight of the moving parts, and to combine this with the curve due to the action of the equalizing cylinders, and that of the expanding steam.

The entire resultant effect Prof. Unwin has plotted, reduced to the same horizontal base as that employed for the load on the pump-plunger plus the resistance due to engine-friction, and the final diagram shows very clearly how nearly the effort and the resistance are balanced in this particular engine.

Doubtless this method of including inertia effects in the diagrams of direct-acting pumping engines, thus first introduced by Prof. Unwin, will be adopted in subsequent tests to advantage and thus place the study of the action of the forces in direct-acting pumps on the same basis as in rotative engines.

The Struggle in the Engineering Industries.

THE exceedingly able paper by J. Stephen Jeans in our September number has placed the merits of this subject so well before the readers of this magazine, and has, doubtless, interested so many in the issues of the great contest in the English engineering trades, that an abstract of an appeal by the English employers to the general engineering industries of the United Kingdom, intended to stimulate resistance to the innovation of a 48-hour week, and to rouse those who, though they should become active in opposition, have hitherto remained indifferent or neutral, will be of further interest. This appeal is very strongly worded. If it fitly represents the feelings of English employers toward their employees, it indicates an intensity of antagonism even beyond what might be inferred from the statements of Mr. Jeans. The appeal (*Iron and Coal Trades Review*, July 30) characterizes the demand for a 48-hour week as ruinous, and states that organized labor has won its battles against the masters simply from the fact that the latter have not opposed to the demands of labor a similarly well-organized resistance. But now, the appeal proceeds, "for the first time in a very long period the masters in our trade throughout the United Kingdom have combined to resist. . . . To permit the men to defeat the masters in the present instance will lead to more vexatious conditions being imposed on our trade than has ever been the case before, bad as these have been. On sound commercial lines, guided by the facts which we, as principals, alone can possess, we know we are in the right. Argument with the labor leaders is useless; labor never descends to argument. . . . Labor only acknowledges one argument, and that is force, . . . Their success in the past is their only justification for their tactics. We must resist them with their own weapons, but ours must be more powerful than theirs, and wielded with greater determination. . . The trades unions never had such a powerful combination of employers to fight before, and cannot fight us

long, except with money raised from members who are still kept at work by employers who are not acting with us. Will you consent to pay wages to your men to help them fight us, your co-employers? or will you sink all trade jealousies and petty considerations by loyally joining us, recognizing that our interests are identical, and that you are thereby protecting yourselves? The claim put forth by the advocates of the eight-hour day that the shortening of the day would result in an increased output per hour is held to be fallacious, and a counter-claim is made, based upon data obtained from prime-cost books, that on certain classes of work the productive results of labor have been for some years less than formerly was the case." With reference to a certain shop wherein the eight-hour day has been adopted, and which professes satisfaction with the system, the appeal says that "they have therein established a system of supervision by extra foremen, and the enforcement of rules so strict that, were they practised by any other firm, they would probably be designated by the union leaders as little better than slave-driving." And it is thought that, were the unions successful in enforcing their demands for a 48-hour week, they would not tolerate the general introduction of such a system. In conclusion, it is shown that the reduction of hours demanded and the abolition of overtime would necessitate the employment of thirty-one per cent. more men in order to obtain the same output.

The British Coal Industry.

THE condition of the British coal industry appears to be far from satisfactory, either to mine owners or to miners. Not only has the proportional output diminished, but prices have also fallen, until it has become a serious question as to whether an international agreement to control production and regulate prices may not become necessary.

A special article in the *Iron and Coal Trades Review* (September 10) discusses the troubles of the situation at length, and at the same time gives some interesting information about the changed position which England now bears toward an industry over which she formerly exercised undisputed control.

Up to about the middle of the present century Great Britain produced about two-thirds of all the coal output of the world. By 1866 this had fallen to 60 per cent.; in 1880, to 46 per cent.; in 1890, to 39 per cent.; and in 1895 to 36 per cent. At the present time the total coal output of the world is about 521,000,000 tons, of which the United Kingdom produces only about one-third. It is probable that fifty years hence Great Britain will not be producing more than a fifth or a sixth of the world's coal output, and that it will long before then have been left behind by the United States and Germany, if not by Russia, China, Canada, New South Wales, and other countries.

Various causes are cited to account for this unfavorable showing, but the one formidable fact which must be faced is the continual growth of foreign competition. The fact must be recognized that the British coal industry, great as it is, has passed its prime, and the present problem is to make the most of present opportunities, since England can never be expected to have a more prominent place in the world's coal industry than she has to-day.

The endeavor now is to find some barrier to stay the ebb of continually-falling prices, and this most naturally has resulted in plans to effect a combination that will to some extent control production, and thus steady prices, even if it cannot advance them. Such a combination, however, to be effective, must not be limited to Great Britain, although a combination controlling all the output of the United Kingdom would represent a capital of £200,000,000, and would be in itself a most important experiment in the aggregation of capital. But the combination would have to be international, and its possible magnitude has not been estimated.

According to a pamphlet recently produced by a continental writer, such a scheme would not aim to diminish the output, or produce an artificial rise in the price of coal, but would tend to "regulate the output," and "distribute the supply

more regularly over every part of the year."

The writer in the *Iron and Coal Trades Review*, however, points out that any such agreement would be useless, unless the United States were included. "Already," says he, "American coal has invaded English markets. Open the sluice-gates by an artificial rise of price, and it would pour in like a flood. No; we may indeed be able to set our house in better order, but international agreement for the salvation of the British coal owner is out of the question, and some more excellent way must be tried."

Just what that "more excellent way" is does not very clearly appear, but at least a harmonizing of conflicting home interests is recommended, ultimately leading to district combinations, uniting into a general coal trust, with all that it involves.

The Dover Tramway.

ELECTRIC TRAMWAYS have until recently made less progress in England than on the Continent, and Europe generally is far behind the United States. England, however, is making up for lost time, and new roads are being projected and completed in many towns.

The *Railway World* (October, 1897) gives a fully illustrated account of the opening of the new electric tramway in the city of Dover, and the installation is of sufficient interest to warrant notice. The overhead-trolley system is used, the wires being supported on poles of decidedly tasteful design with ornate wrought iron brackets, and the effect is by no means unsightly. The mechanical and electrical features require no especial comment in these pages other than to state that Babcock & Wilcox boilers furnish steam to McIntosh & Seymour engines driving Thomson-Houston generators, so that the United States has furnished its due share of the plant.

Before the decision was made to introduce electricity as a motive power, comparative bids were had for operating the road on the Luhrig gas system. The first cost of the gas plant was about £8,000, against £12,780 for the electrical system, but the bid of the gas company for operating was 6½d. per car mile against 6d. per car mile for electricity, a difference which would much more than pay the interest on the larger capital required for the construction, the saving increasing rapidly with the increase of traffic. An attempt was made to introduce an act limiting the speed to 8 miles an hour, but after some contention this was only adopted provisionally, and higher speeds may be used subject to the assent of the Board of Trade. At the present time the road is only about 3¼ miles long, and in order to secure travel the low fare of 1d. is charged, instead of 4d. previously charged by the omnibus company for the same distance.

The development of overhead trolleys in English towns will be watched with interest, especially as to the influence which may be exerted upon public opinion in the metropolis about overhead wires. The *Railway World*, in commenting upon this point, remarks: "We may add that the feeling regarding the overhead system, now that it has become familiar, is not unfavorable. As in Bristol, Coventry, and Leeds, there are no complaints, but a general wish that the tramways should be extended. It is the almost universal evidence that the anticipatory objections to the trolley system, as constructed in this country, have no foundation in fact. Why then, we are constrained to ask, should London wait? Cannot the County Council find courage enough to allow an experimental line, for instance, in the remote region of Hammersmith? Let them ask the Dover Council for advice: the reply would be interesting and useful."

THE CONTINENTAL PRESS

A Proposed Russian Ship Canal.

THE general interest developing in various parts of Europe in all matters relating to internal waterways seems to have extended to Russia, and a plan has now been made to construct a ship canal connecting the Baltic and Black seas by way of the rivers Duna, Beresina, and Dnieper. The terminal ports contemplated are Riga on the Baltic, and Kherson on the Black sea, and, as the greater portion of the distance is covered by the above-named rivers, the artificial waterway comes within reasonable limits of engineering construction.

According to an account in the issue of the *Zeitschr. d. Oesterr. Ing. u. Arch. Vereines* for August 13, the local conditions are especially favorable. The entire southern Russian plateau, in which the canal would be dug, is composed of a light layer of sandy soil upon a continuous bed of clay, admirably adapted for the construction of a water-tight channel, and—what is still more favorable—the variations in level are so slight that no locks whatever would be required.

The entire length of canal is estimated to be about 1,000 miles, and the proposed channel is to be more than 200 feet wide at the narrowest portion and 28 feet deep. The plans include docks at Riga and at Kherson, and the estimated cost, including all improvements, bridges, aqueducts, etc., is $100,000,000.

The great value of such a waterway lies not only in the communication which it would furnish between the two seas, and the local traffic through the richest portion of the empire, but also in the fact that it would place the northern nations of Europe in direct water communication with India and the east, through the Suez canal, by way of the Black sea and the Baltic.

It is proposed to finance the scheme by a government loan at 4½ per cent., the government to receive one-third of the net receipts during the concession period of sixty-six years, after which the canal will revert to the government without fnrther payment. The earning capacity of the canal is estimated on a basis including travel both by day and by night, it being planned to equip the work with electric lights from the start.

Although the plans for this great work are as yet only in a preliminary stage, there seems to be nothing to prevent successful execution, so far as engineering problems are concerned; and money expended upon internal improvements should prove at least as good an investment as that allotted to military purposes.

The Traveling Platform at the Paris Exposition.

THE administration of the Paris Exposition of 1900 is already making plans for intramural transportation, this being especially necessary in view of the scattered nature of the area under consideration.

Many of the visitors at the World's Fair at Chicago will remember the traveling sidewalk with double speed which operated upon the pier, and it is a modification of this device which has been submitted for adoption at Paris on a much larger scale.

The traveling platform, as it is called, is described and illustrated very fully in the issue of the *Génie Civil* for July 3, the difference between the proposed construction and that at Chicago being mainly in details and magnitude. It is proposed to build the roadway upon an elevated structure similar to that of the elevated roads in New York, or the Intramural Road at Chicago, with convenient stations at intervals, two speeds being furnished, and the whole being propelled by electric motors.

The whole design, which is that of MM. Blot, Guyenet, and de Mocomble, shows evidence of a full appreciation of the difficulties of the problem when con-

sidered upon so large a scale, as the proposed system is intended to pass entirely around three sides of the Champ de Mars, along the Quai d'Orsay and the length of the Esplanade des Invalides, back to the Champ de Mars, forming a continuous circuit about three miles in length.

In the Chicago moving sidewalk the high-speed portion was provided with rails beneath, these rails resting on the tops of the rims of the wheels supporting the slower section, and thus a double speed was obtained without additional mechanism. This plan, however, is not thought desirable for so long a road as that at Paris, as the weight adds much to the momentum of the platform, and the absence of springs makes the motion rough and uncomfortable.

The proposed platform system consists of two entirely distinct portions, each with its own motive power, and each forming a continuous and endless platform traveling around the circuit of the grounds. The high-speed portion is intended to have a speed of about six miles an hour, and the slow section one-half as great a velocity, while a stationary sidewalk of ample width runs along the entire length of the circuit, enabling visitors to leave at any portion of the grounds and descend to the surface by the nearest stairway.

One of the valuable points of such a system is its great capacity, as practically the entire circuit is available for passengers, and no time is wasted in stopping and starting. Seats are to be provided on the high-speed portion of the platform, and it is estimated that fifty thousand passengers can readily be transported per hour. The length of the route, as planned at Paris, will demonstrate the practicability of the system for city streets, and the successful outcome of the construction at the Exposition may lead to decided modifications in existing overhead transportation systems in large cities. The absence of noise, smoke, and dirt, together with freedom from crowding, waiting for trains, and all the inconveniences of the present system, certainly furnish ample inducements for a further investigation of the success or failure of the installation.

Foundations in Compressed Earth.

AT a recent meeting of the Society of Civil Engineers of France a simple method of constructing foundations in soft earth was discussed, and, as the subject is one of sufficient interest to be more widely known, we give a somewhat detailed account of the method, from the issues of the *Moniteur Industriel* for July 17 and 24.

The method is due to M. Louis Dulac, and consists in an ingenious mechanical compression of the soil. It is well known that, when a stake is driven into the ground, a compression of the surrounding soil takes place, equal in volume to that displaced by the stake. In the method of M. Dulac an apparatus like a pile-driver is erected, but, instead of the ordinary hammer-head ram, a heavy cone is allowed to drop, point down, in such a manner that it makes a hole, the size and depth of which depend upon the diameter of the cone and the height from which it has fallen.

The cone generally used is from 24 to 30 inches in diameter, weighing about 3,000 pounds, and it is dropped from a height of 30 to 40 feet. With a drop of this sort a hole equal in diameter to that of the cone and 20 to 30 feet deep may be made in a few hours, the time and depth depending of course upon the nature of the soil. The whole area upon which the structure is to be erected is thus treated, the holes being 5 to 6 feet apart between centers; and the result is the compression of the soil between the holes to an extent governed by the diameter and distance between them.

After the holes have thus been made, they are gradually filled with a concrete made of broken stone or cinder and hydraulic lime or cement. The concrete is thrown in in shallow layers, and pounded by allowing a spherical weight of about 2,000 pounds to drop from about the same height as that from which the cone was dropped. The effect of this procedure is to drive the more liquid portion of the concrete into the walls of the pits, and thus, when the latter are filled and the concrete has become hard, the foundation consists not only of the buried pillars of

stone and cement, but also of the compressed earth partly charged with cement.

This method of making foundations has been used with much success in various portions of Paris, some of the locations being considered very difficult, owing to the soft nature of the soil; and the system is now being used to prepare the ground for the erection of some of the buildings for the exposition of 1900.

The effect of the pounding of the earth is said not to extend to sufficient distance to disturb adjacent structures, and in a number of cases the method has been used in the immediate vicinity of old and weak buildings without apparent injury.

It is possible that this system of compression may be of service in many locations where the load is not too great, and it appears to be of especial applicability to foundations for temporary structures, avoiding the necessity of much digging.

The Entropy Diagram and its Applications.

THE modern science of thermodynamics is becoming more and more freely applied in practical operations, and a working familiarity with its methods and applications may be said to be a necessity for those who desire to study intelligently the transformations between heat and work in engines of various forms.

In many instances, however, the theoretical discussions of the subject are so burdened with elaborate mathematics and so far removed from practical working application that the practising engineer finds small satisfaction in them. A very valuable series of articles upon the subject of the practical application of the entropy diagram has appeared in the issues of the *Revue de Mécanique* from January to June of this year, from the pen of Professor Boulvin, of the University of Ghent, who presents the subject with a minimum of mathematics, and shows very clearly how the method may be practically applied with ease.

After explaining the fundamental principles involved and the relation between the principle of Carnot and the entropy diagram, or *theta-phi* diagram, as its originator, Mr. Macfarlane Gray, has called it, Professor Boulvin proceeds first to apply the diagram to the investigation of a gas engine of the Otto type, taking his data from a test made by Prof. Capper on a 7-h. p. Otto-Crossley engine and constructing the entropy diagram from the indicator diagrams and other data of the test. He then passes to the more involved questions of vapors of various kinds, both saturated and superheated, with numerous diagrams showing the practical application of the principles.

The last article is devoted to the discussion of the entropy diagram as applied to the steam engine, and a practical case is fully worked out in a thorough and lucid manner. In closing, Professor Boulvin shows how the diagram may be applied to the steam turbine, and demonstrates that the impulses upon the successive wheels or vanes result in practically the same effect as that of the pressure of steam upon a piston in a cylinder.

It is gratifying to find so clear and practical a series of papers upon a subject so easy to obscure, and we again congratulate the author upon the manner in which he has handled it.

The Bouzey Dam Disaster.

THE terrible disaster of the failure of the Bouzey dam, in which eighty-four lives were lost and a vast amount of property ruined, has been discussed in many publications, but the recent report of the criminal proceedings before the *tribunal correctionnel d'Epinal* has reopened the subject, and M. A. Dumas reviews not only the judicial proceedings, but also the engineering evidence which the investigation has brought out. From his papers in the issues of *Le Génie Civil* for July 10, 17, and 24 we condense the salient points.

The hearing was the occasion for the exercise of much able legal and technical work, and the charge of homicidal negligence which had been brought against the department engineers and inspectors of the dam was finally dismissed. Upon the justice of this decision M. Dumas refrains

from commenting, but, instead, reviews the testimony on his own account.

The testimony of the experts shows the following causes for the disaster:

1. Defective foundations.
2. Poor quality of materials.
3. Extreme narrowness of section.
4. Defective horizontal plan.
5. Defects in the repairs executed in 1888.
6. Carrying an unnecessarily high water-level in the reservoir.
7. Insufficient inspection service.

The first five of these points were known—to some at least—several years before the disaster, as the yielding which led to the repairs and reinforcement in 1888 revealed a deformation in portions of the dam as well as imperfections in the foundations and material of the original structure.

The materials were known to be of only moderate quality, from tests made at the time the dam was built, but the desire to use the stone and sand found in the vicinity overruled the question of quality. Had this fact been met by a corresponding increase in dimensions, there would have been less cause for criticism, but, as a matter of fact, the thickness of the middle portion of the dam was made even less than the best of materials would have warranted. It was shown that the line of pressure in the masonry passed considerably without the middle third of the profile when the reservoir was filled, thus subjecting the inner wall to a tension which would have severely tested the resisting power of the best masonry. The reinforcement added to the dam at its base in 1888, while materially strengthening the whole structure against the slippage which then threatened it, was not carried high enough to modify the position of the pressure line at the thin portion, and it was to this very weak section undoubtedly that the disaster was mainly due.

So far as inspection is concerned, it was shown that the rupture was not preceded by preliminary indications of weakness sufficient to warrant serious apprehensions. On the contrary, the fears which had been raised by the deflections noticed several years before had been thoroughly allayed by the cessation of further motion, and the confidence of the department engineers in the stability of the structure seems to have been fully restored at the time of the failure.

An examination of the ruins of the dam made by a special commission of experts consisting of MM. Brüll, Fleury, and Langlois, supplemented by an inspection by M. Maurice Lévy, gave indications that the rupture occurred both by cracking under tension and by shearing, the latter probably having taken place after the first breach had been made. Attempts were made to show that the dam had been weakened by the effect of the preceding severe winter, but no satisfactory evidence could be found to sustain this view.

While the charge of criminal negligence against the department engineers and inspectors was held not to have been made out, the responsibility for the failure was morally placed upon the general council of the *Ponts et Chaussées*, since the plans for the dam were submitted to and fully approved by it. A proper examination of the section adopted, and of the details of construction, should have revealed in advance the essential weakness of the design, and the fearful results which followed cannot be considered as other than the natural effects of perfectly obvious causes, which should have been so apparent as to be entirely preventable, either at the original time of construction or at the time of the subsequent repairs.

Military Bicycles.

EARLY in the history of the bicycle its possible value in warfare was perceived by various tacticians, but mechanical difficulties, especially in regard to weight and portability, have delayed its practical introduction. Of late, however, we have heard more of the real value of the wheel, especially as a means of enabling reconnoitring parties to scour the country in advance of a main column. The efficiency of the wheel for such service has been fully demonstrated in the United States by the very successful run of Lieutenant Moss and his party from Fort Missoula, in Montana,

to St. Louis,—a distance of 1,900 miles over very rough country.

In the issue of *Stahl und Eisen* for July 15 is given some account of the experiments which have been made with military bicycles by some of the continental powers, from which it appears that in nearly every army there is at least one bicycle company under training for this special service.

The first country to appreciate the importance of the subject was France, and at the present time there are 25 French bicycle companies, 7 of which consist of 5 officers, 29 non-commissioned officers, and 170 men each. The remaining 18 contain 3 officers, 16 non-commissioned officers, and 98 men each, the whole forming the eighteenth army corps. These are all mounted on the Gérard portable wheel, which can be disconnected in one minute, the two wheels being placed together and the whole slung upon the soldier's back for transportation over country in which riding is impossible. The weight of the Gérard military wheel is 27½ pounds, which is light enough for the heavy nature of the service.

Bicycle companies are also in drill in the armies of Austria, Prussia, Saxony, and Bavaria, and in all cases the opinion of military men is growing more and more favorable toward the mechanical steed. The matter of forage, one of the most difficult problems of army maintenance, is solved by the introduction of the wheel. The military powers are becoming more convinced of the controlling importance of the infantry, and now regard cavalry as of value mainly for its ability to make rapid advances; but infantry regiments mounted on bicycles may soon render cavalry obsolete.

The wheel used in the Prussian army, and shown in *Stahl und Eisen*, is made with the drop and saddle so low that both feet can be placed on the ground without dismounting; thus the soldier can stand with the bicycle between his legs and handle his musket freely, being at the same time ready for instant motion. Most of these wheels are provided with pneumatic tires, although in the Prussian service cushion-tires are also used, as it is feared that in actual service many wheels would otherwise be disabled through punctures.

In France Captain Charrollois has designed an apparatus for enabling telephone wires to be rapidly laid from a bicycle, and quadricycle ambulances have been made for field hospital use in several countries, including the United States.

The severe tests to which the various form of military bicycles are being put in times of peace will probably result in the development of a wheel especially adapted to the service.

For this purpose the tire should be practically non-puncturable, and all parts should be as strong as possible; yet the whole affair must be readily portable upon the shoulders of the rider, without impeding him excessively in getting across a plowed field or a rocky valley.

The Development of Hydraulic Power.

THE influence which the introduction of electric transmission has exercised upon the development of hitherto unused water powers has been noted repeatedly in these pages, but its growing importance is made apparent by the frequent references to new plants and applications. This is true in various countries, and in *La Revue Technique* for August 25, and in the *Zeitschr. des Ver. deutscher Ingenieure* for August 14, the subject is brought out by reference to new or contemplated installations.

In the former journal M. Durandy calls attention to the resources of the Alpine departments of France. In the departments of Savoie, Haute-Savoie, and Isère the power of the mountain streams has been utilized to a large extent already, and a company has now been formed to develop the water power of the Maritime Alps in a systematic manner.

Of the sites controlled by the company there are three of especial importance,—namely, the fall of Mesela, the fall of Plan du Var, and the fall of Cians. The first two of these utilize the water of the Var, furnishing about 700 cubic feet per second, with a fall of about 38 feet in the first case and 70 feet in the second.

Taking into account the various losses, it is estimated that these two plants will develop 2,000 and 4,000 h. p. respectively, but the construction of the plants will involve some tunnelling in order to take advantage of the sudden curves of the stream through its rocky channel, and obtain the necessary fall within a short length.

The third site is one of reverse conditions, the fall being great and the volume small. By the construction of a short canal a fall of 400 meters, or about 1,300 feet, can readily be obtained, but the volume of water available is only about 28 cubic feet per second, from which, however, at such a head, an effective development of 3,200 h. p. can be obtained.

None of these installations is as yet constructed, but the first is now under way, and is expected to be completed within a year, while the others will follow as the demand for power warrants. It is expected that these new developments of hydraulic power will be of increasing importance, because of the neighborhood to the Mediterranean ports, thus bringing manufacturing and water transportation in close proximity.

The article in the *Zeitschr. des Ver. deutscher Ingenieure* is by the well-known electrician, Herr Uppenborn, and describes some of the new hydraulic and electric plants already completed and in operation in various parts of Germany and Switzerland.

Among these may be mentioned the power plant at Hollriegelsgreuth on the Isar above Munich, where a volume of about 2,000 cubic feet per second is given a fall of nearly 10 feet by a dam, more than 2,000 h. p. being developed for electric lighting and power in Munich.

In Switzerland, the hydraulic plant at La Goule, in the Bernese Jura, is of interest from the fact that the water of the Doubs is conducted through a tunnel, and then through a closed pipe 7 feet 4½ inches in diameter, giving an effective head of 82 feet capable of developing about 4,000 h. p., although the turbines as yet in use give only 2,000 h. p. Current is furnished from this station, both for lighting and power. Some data are given as to charges, which would be more valuable if they were more comprehensive. For motors of 2 to 12 h. p., the price is about $50 per horse power per year, but special terms are made for larger powers. Current is distributed within a radius of 10 to 15 miles, the loss in transmission averaging about 10 per cent. for lighting, and 20 per cent. for power.

Another recent Swiss power plant is that at Zufikon-Bremgarten, where the power of the Reuss is utilized by taking advantage of the fact that the river makes a bend of nearly 180°, and that there is a difference in level of nearly 18 feet between two points in the stream which are thus brought so near to each other that a short canal through the intervening neck of land enables the water to be brought across. A canal less than quarter of a mile long thus permits the utilization of about 1,300 h. p., of which nearly 800 h. p. is distributed in small motors in Zurich, 240 h. p. is used in the large flouring mills of that city, and the rest is used for lighting purposes.

A New Bridge at Berne.

THE city of Berne is situated in a loop of the river Aar, upon a sort of rocky promontory which it has long since outgrown, so that upon the opposite banks of the stream a number of suburbs form part of the present city. Several bridges have been thrown across the river to facilitate communication with the outlying portions, the best known of these being the stone arch of the Nydeck bridge, of one hundred and forty-seven feet span. Among the other bridges may be mentioned the Kirchenfeldbrücke, connecting the cathedral place with the so-called Helvetia Platz, and the high iron-arched railroad bridge. The most recent structure is the new Kornhausbrücke, to which reference has already been made in these pages and, which will not be completed until the end of next year.

A competition has just been closed for plans for still another bridge across the Aar, to connect the western end of the promontory with the suburb known as the Lorraine quarter, and the leading designs

are given in the issues of the *Schweizerische Bauzeitung* for August 14, 21, and 28, and September 4, with interesting details.

The first prize of eight thousand francs was awarded to a design consisting of a main stone arch spanning the river, with stone viaduct approaches. Owing to the steepness of the banks, the rise of the arch is greater than the half-span, and the form of arch curve is made to conform almost exactly to that of the equilibrium curve for the conditions involved. The span is 60 meters, and the rise 35 meters, or 197 feet by 115 feet, the roadway being carried upon small spandrel arches supported by slender piers reaching down to the main arch ring. The whole outline of the equilibrated arch is thus revealed, there being no solid backing, as none is necessary with this strictly correct solution of the problem. The drawings show the beauty of this practical application of the theoretical principles of arch-construction. While admitting the excellence of some of the other designs shown, we cannot refrain from congratulating the judges on their wisdom, and the engineers (MM. Robert Moser and Gustav Mantel, of Zurich) on their ability.

It is to be hoped that this most admirable design will be executed in strict conformity to the original plans now shown, and that another ornament of modern bridge-construction will thus be added to the capital of Switzerland.

The Simplon Tunnel.

NUMEROUS projects have been proposed for the construction of a tunnel through the Alps at the Simplon pass, but it was not until 1895 that the Swiss and Italian governments arrived at a satisfactory agreement for the prosecution of the undertaking.

The plan now adopted is that of the Simplon-Jura Railway, and involves a tunnel 6.7 miles long; the scheme is unique in some of its details. As at first constructed, the tunnel is to be single track, but there is to be an auxiliary tunnel parallel to the main one, connected to it at intervals by cross galleries. The second tunnel is to be used for ventilating purposes in connection with powerful fans, and, if the demands of travel require a double track, the second tunnel can be enlarged for the purpose. The distance between the two tunnels is to be 56 feet from center to center, and the connecting passages are to be about 650 feet apart.

The present estimates place the cost of the tunnel at fifteen million dollars, and the time for completion at five and a half years. Since the new tunnel will be at a decidedly lower altitude than any of the other Alpine tunnels, it is expected that a much higher rate of speed can be maintained on the road. The maximum altitude of the Simplon tunnel will be only 2,300 feet above the sea, while the elevation of the St. Gothard is 3,800 feet, the Mont Cenis 4,240 feet, and the Arlberg 4,300 feet.

The Simplon tunnel will provide a much-needed railway communication between French Switzerland and Italy, placing the upper Rhone valley in the through line of travel, and cannot fail to be of advantage to the many beautiful towns about the Lake of Geneva.

The Exposition of 1900.

IT is the proper thing now for every great exposition to have its side shows, and the "*rue de Caire*" of the Paris exposition of 1889 was undoubtedly the prototype of the various "streets" and midways which have appeared since then. In the coming exposition of 1900 it is proposed to vary this theme by having a "*rue de Tokio*," of which some description is given in *La Revue Technique*. This street is to be a veritable reproduction of a Japanese thoroughfare, containing shops in which wares are to be not only sold, but manufactured, and where all the dainty industries of the Japanese may be seen as at home. A Buddhist temple is to be constructed, the service to be conducted in the same manner as in Japan, while in a beautiful garden beyond will be found restaurants, theatres, dancing-halls, and all the shows which the traveller to the flowery isles expects to find. If the idea is properly and completely carried out, a most attract-

ive display may be made, but it will require much patient work and sharp watching to keep such an exhibit from degenerating into a mere money-making scheme of little interest and no real value.

Bleaching by Electricity.

THE increasing number of applications of electricity to chemical and technological industries cannot fail to attract the attention of all who are interested in the commercial development of industrial operations. Among these applications one of the more recently successful is that of substituting electrical decomposition of chlorine salts for bleaching purposes for the older chlorid of lime method.

An article in the *Moniteur Industriel* for June 5 gives an account of the latest improvements in electric bleaching, from which we condense the essential points.

In the decomposition of a solution of sea salt by the electric current without the interposition of a diaphragm, the products obtained are chlorine and caustic soda, which immediately recombine to form hypochlorite of soda, the active agent in a bleaching solution. But at the same time with this principal reaction there exist secondary reactions which reduce the useful effect of the principal, these consisting mainly of the formation of chlorate, and the reduction of a portion of the hypochloriteto chlorid of sodium. Another source of difficulty lies in the electrodes. If these are of carbon, the rapid wasting away is a source of loss, and, furthermore, fouls the bath, necessitating frequent filtration. Platinum electrodes have been suggested, but the expense adds to the original cost of the plant, increasing the fixed charges.

The difficulty of the electrodes has been overcome by Dr. Kellner, who has devised an electrode consisting of a sheet of hard rubber armed with a number of platinum points like the bristles of a brush, and by the use of these terminals, and with the employment of special care as to the strength of current and temperature of bath, he has succeeded in obtaining electrolytically solutions containing about one per cent. of hypochlorite, which is a degree of concentration more than sufficient for all practical purposes.

A number of experiments have demonstrated that electrolytic solutions can be successfully employed in the bleaching of paper pulp, cotton, jute, flax, etc., with less injury to the material than occurs with bleaching powder, and that, with proper skill in installation and operation, a decided economy is also effected.

As in most electrical industries, the cost of the power is an important item in the operating expense. When hydraulic power is available, estimated in France as costing about $25 per h. p. per annum in 100-h. p. units, the electrical bleaching is decidedly cheaper than the older methods, and, even when steam power is required, estimated at $70 per h. p. per annum, there is an appreciable saving in cost, not taking into account the greater uniformity of results and reduced injury to the product.

Physiological Action of X Rays.

THERE has been some talk about the injurious action to the system of a prolonged exposure to the action of the Röntgen rays, and, according to a note communicated to the French Academy by M. dArsonval, on the part of MM. Seguy and Quenisset, a violent palpitation of the heart is caused when the exposure is very long. M. Seguy observed this effect in a number of instances, and M. Quenisset caused a subject to be exposed to the rays for a length of time sufficient to enable their therapeutic action to be observed. These latter experiments produced a great oppression in the region of the heart, followed by violent and irregular palpitations, which became almost insupportable when the rays traversed the chest. When, however, a thick plate of metal was placed so as to intercept the rays in the vicinity of the heart, relief followed, and the results of these experiments indicate that this precaution should always be observed when the exposure is prolonged.

THE ENGINEERING INDEX

INTRODUCTORY

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American Architect. *w.* Boston, Mass.
American Electrician. *m.* New York.
Am. Engineer and Railroad Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, Minn.
American Journal of Science. *m.* New Haven, Conn.
American Journal of Sociology. *b-m.* Chicago, Ill.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. *w.* Pittsburg, Pa.
American Shipbuilder. *w.* New York.
Am. Soc. of Irrigation Engineers. *qr.* Denver, Col.
Am. Soc. of Mechanical Engineers. *m.* New York.
Annals of Am. Acad. of Pol. and Soc. Sci. *b-m.* Phila., Pa.
Annales des Ponts et Chaussées. *m.* Paris.
Architect. *w.* London.
Architectural Record. *q.* New York.
Architectural Review. *s-q.* Boston, Mass.
Architecture and Building. *w.* New York.
Architektonische Rundschau. *m.* Stuttgart.
Atlantic Monthly. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Bankers' Magazine. *m.* New York.
Bankers' Magazine. *m.* London.
Bankers' Magazine of Australia. *m.* Melbourne.
Berg- und Hüttenmännische Zeitung. *w.* Berlin.
Board of Trade Journal. *m.* London.
Boston Journal of Commerce. *w.* Boston, Mass.
Bradstreet's. *w.* New York.
Brick Builder. *m.* Boston, Mass.
British Architect. *w.* London.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Phila., Pa.
Bulletin of the Univ. of Wisconsin, Madison, Wis.
California Architect. *m.* San Francisco, Cal
Canadian Architect. *m.* Toronto, Ont.
Canadian Electrical News. *m.* Toronto, Ont.
Canadian Engineer. *m.* Montreal, P. Q.
Canadian Mining Review. *m.* Ottawa, Ont.
Century Magazine. *m.* New York.
Chautauquan. *m.* Meadville, Pa
Colliery Engineer. *m.* Scranton, Pa.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris
Contemporary Review. *m.* London
Deutsche Bauzeitung. *b-w.* Berlin.
Dingler's Polytechnisches Journal. *w.* Stuttgart.
Domestic Engineering. *m.* Chicago, Ill.
Eclairage Electrique. *w.* Paris.
Electrical Engineer. *w.* London.
Electrical Engineer. *w.* New York
Electrical Engineering. *m.* Chicago, Ill.
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Electrical Review. *w.* New York.
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Electrician. *w.* London.
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Electricity. *w.* New York.
Electricity. *w.* London.
Elektrochemische Rundschau. *b-m.* Frankfurt.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnisches Echo. *w.* Magdeburg.
Elektrotechniker. *b-m.* Vienna.
Elektrotechnischer Anzeiger. *s-w.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Engineer. *s-m.* New York.
Engineer. *w.* London.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering Assn. of the South. Nashville, Tenn.

Engineering and Mining Journal. *w.* N. Y.
Engineering Magazine. *m.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of the School of Prac. Sci. Toronto, Ont.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, Pa.
Fire and Water. *w.* New York.
Forester, The. *bi-m.* May's Landing, N.J.
Fortnightly Review. *m.* London.
Forum. *m.* New York.
Foundry. *m.* Detroit, Mich.
Garden and Forest. *w.* New York.
Gas Engineers' Mag. *m.* Birmingham, Eng.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Glasers Ann. für Gewerbe & Bauwesen. *s-m.* Berlin.
Gunton's Magazine. *m.* New York.
Harper's Weekly. *w.* New York.
Heating and Ventilation. *m.* New York.
Ill. Carpenter and Builder. *w.* London.
India Rubber World. *m.* New York.
Indian and Eastern Engineer. *w.* Calcutta.
Indian Engineering. *w.* Calcutta.
Industries and Iron. *w.* London.
Inland Architect. *m.* Chicago, Ill.
Iron Age. *w.* New York.
Iron and Coal Trade Review. *w.* London.
Iron & Steel Trades' Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Jour. Am. Soc. Naval Engineers. *qr.* Wash., D. C.
Journal Assoc. Eng. Society. *m.* St. Louis, Mo.
Journal Franklin Institute. *m.* Phila., Pa.
Journal of Gas Lighting. *w.* London.
Jour. N. E. Waterw. Assoc. *q* New London, Conn.
Journal Political Economy. *q.* Chicago, Ill.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Journal of the Society of Arts. *w.* London.
Journal of the Western Soc. of Eng. *b-m.* Chicago, Ill.
Kansas University Quarterly. *qr.* Lawrence, Kan.
Locomotive Engineering. *m.* New York.
Machinery. *m.* New York.
Machinery. *m.* London.
Manufacturer's Record. *w.* Baltimore, Md.
Marine Engineer. *m.* London.
Marine Engineering. *m.* New York.
Master Steam Fitter. *m.* Chicago, Ill.
Mechanical World. *w.* London.
McClure's Magazine. *m.* New York.
Metal Worker. *w.* New York.
Mining and Sci. Press. *w.* San Francisco, Cal
Mining Industry and Review. *w.* Denver, Col.
Mining Journal. *w.* London.
Mittheilungen des Vereines für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Monatsschrift des Württ. Vereines für Baukunde. 10 parts yearly. Stuttgart.
Moniteur des Architectes. *m.* Paris.
Moniteur Industriel. *w.* Paris.
Municipal Engineering. *m.* Indianapolis, Ind.
National Builder. *m.* Chicago, Ill.
Nature. *w.* Paris.
Nature. *w.* London.
New Science Review. *qr.* New York.
Nineteenth Century. *m.* London.
North American Review. *m.* New York
Oesterr. Monatsschr. für den Oeff. Baudienst. *m.* Vienna.
Oesterr. Zeitschrift für Berg- & Hüttenwesen. *w.* Vienna.
Physical Review. *b-m.* New York.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineer's Club. *q.* Phila., Pa.
Proceedings of Central Railway Club.
Pro. of Purdue Soc. of C. E. *yr.* La Fayette, Ind.
Progressive Age. *s-m.* New York.
Railroad Car Journal. *m.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago, Ill.
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Railway Master Mechanic. *m.* Chicago, Ill
Railway Review. *w.* Chicago, Ill.
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Review of Reviews. *m.* New York.
Revue Technique. *b-m.* Paris.
Sanitarian. *m.* Brooklyn, N. Y.
Sanitary Plumber. *s-m.* New York
Sanitary Record. *m.* London.
School of Mines Quarterly. New York
Schweitzerisches Bauzeitung. *w.* Zurich.
Science. *w.* Lancaster, Pa.
Scientific American. *w.* New York
Scientific Am. Supplement. *w.* New York
Scientific Machinist. *s-m.* Cleveland, O.
Scribner's Magazine. *m.* New York
Seaboard. *w.* New York.
Sibley Journal of Eng. *m.* Ithaca, N. Y.
Southern Architect. *m.* Atlanta, Ga
Stahl und Eisen. *s-m.* Dusseldorf.
State's Duty. *m.* St. Louis, Mo.
Steamship. *m.* Leith, Scotland.
Stevens' Indicator. *qr.* Hoboken, N. J
Stone. *m.* Chicago, Ill.
Street Railway Journal. *m.* New York
Street Railway Review. *m.* Chicago, Ill
Technology Quarterly. Boston, Mass.
Tradesman. *s-m.* Chattanooga, Tenn
Trans. Assn. C. E. of Cornell Univ. Ithaca, N. Y.
Trans. Am. Ins. Electrical Eng. *m.* New York
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. Civil Engineers. *m.* New York
Transport. *w.* London.
Western Electrician. *w.* Chicago, Ill.
Western Railway Club, Pro. Chicago, Ill.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Wisconsin Engineer. *qr.* Madison, Wis.
Yale Scientific Monthly. *m.* New Haven, Conn.
Zeitschrift für Lokomotivführer. *m.* Hannover.
Zeitschrift für Maschinenbau & Schlosserei, Berlin.
Zeitschrift des Oesterr. Ing. und Arch. Ver. *w.* Vienna.
Zeitschrift des Ver. Deutscher Ingenieure. *w.* Berlin.
Zeitschrift für Elektrochemie. *s-m.* Halle, a. S.
Zeitschrift für Elektrotechnik. *s-m.* Halle a. S.
Zeitschrift für Instrumentenkunde. *m.* Berlin.

ARCHITECTURE AND BUILDING.

CONSTRUCTION AND DESIGN.

Clinic Building.

A New Clinic for Philadelphia. Description with plans of what is believed to be the finest and largest clinical amphitheatre either in the United States or Europe. Describes in detail the warming and ventilation of the building. 3000 w. Eng Rec—Sept. 4, 1897. No. 15042.

Club House.

The Hollywood Inn. Illustrated description of a workingman's club, at Yonkers, N. Y. 800 w. Harper's Wk—Sept. 18, 1897. No. 15354.

Colombo.

The Victoria Buildings, Colombo. Description, with illustration, of new buildings of architectural pretensions, recently erected. 2000 w. Ind Engng—Aug. 28, 1897. No. 15603 D.

Co-operative Residences.

The Coleman-Stuckert System of Co-operative Residences. Florence May Gardiner. Describes the model homes for the middle classes as planned by Mrs. Coleman-Stuckert. Ill. 1800 w. San Rec—Sept. 17, 1897. Serial. 1st part. No. 15539 A.

Ferry House.

A Handsome Metal Ferry House. Illustrated description of the building erected by the Pennsylvania Railroad Company at Twenty-third street and Eleventh avenue, New York. It is of iron construction and covered with sheet metal inside and out. 900 w. Met Work—Sept. 11, 1897. No. 15218.

Library.

Chicago Public Library. Illustrated description of a fine building of classic style. 1600 w. Harper's Wk—Sept. 18, 1897. No. 15355.

Museum.

The Competition for the Technical Museum of Northern Bohemia at Reichenberg. (Zum Wettbewerb des Nordböhmischen Gewerbemuseums in Reichenberg.) A discussion, with plans, elevations and sections, of the two most important designs submitted. 5000 w. Wiener Bauindustrie Zeitung—July 15, 1897. No. 15193 B.

Roofing.

Slate and Copper Roofing in Fireproof Buildings. William Neubecker. Illustrated description of the best methods to follow in the construction of these roofings. 1200 w. Met Work—Sept. 4, 1897. No. 15069.

Spring House.

Competitive Designs for Buildings for the Giesshübl Springs. (Entwurf für einen "Quellentempel" in Giesshübl.) Description and phototype illustrations of competitive drawings for ornate buildings over the medicinal springs at Giesshübl. 3 plates. 1200 w. Wiener Bauindustrie Zeitung—July 1, 1897. No. 15192 B.

Town House.

The Modern Town House. A criticism of the houses of London in general, with brief description of the house built by Mr. Barnato. 1600 w. Ill Car & Build—Sept. 3, 1897. No. 15295 A.

Theatre.

The West End Theatre in Berlin. (Das Theater des Westens in Berlin.) Description of this handsome new theatre in the fashionable quarter of Berlin, with plans and phototypes of the exterior and interior. 4000 w. 4 plates. Wiener Bauindustrie Zeitung—June 3, 1897. No. 15191 B.

Warehouses.

The Grain Warehouses of Braïla and Galatz. (Les Silos des Ports de Braïla et de Galatz.) Describing the new and important grain warehouses in these two important Danube ports in Roumania. 1500 w. 1 plate. Le Génie Civil—May 15, 1897. No. 15140 D.

HEATING AND VENTILATION.

Clinic.

Ventilation of the Polhemus Memorial Clinic. Illustrated description of a ventilating plant of particular interest on account of the height, number of occupants, vitiating elements, and that the construction was such that flues in the outside wall were in no case possible. 2500 w. Eng Rec—Sept. 25 1897. No. 15586.

Combination.

Combination Heating and Cooling Systems. Suggestions for a combination system to be used for cooling in the summer and heating in the winter. 2000 w. Heat & Ven—Sept. 15, 1897. No. 15449.

Furnace Heating.

An Aspirating Furnace Heating System. Explains the nature of the ground, and the arrangements of the buildings of the First Universalist Society, of Buffalo, N. Y., with the interesting features of the heating system. 1800 w. Met Work—Sept. 18, 1897. No. 15418.

Hot-Water System.

A Single-Pipe System of Hot-Water Heating. Illustrated description of heating system in the residence of H. E. Baumann, of Charlotte, Mich., which is said to be unusually effective and economical. 700 w. Met Work—Sept. 18, 1897. No. 15417.

Local Ventilation.

Local Ventilation of Water Closets and Other Plumbing Fixtures. James J. Lawler. The importance of giving attention to this subject especially in the home, with illustration as a suggestion of what can be done. 1500 w. Dom Engng—Sept., 1897. Serial. 1st part. No. 15501 C.

School.

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Steam Heating.

Starting Up a Steam-Heating Plant. W. H. Wakeman. Calling attention of the inexperienced to points needing examination before the plant is started. 900 w. Am Mach—Sept. 30, 1897. No. 15626.

Steam-Heating Apparatus in a Country Residence. Illustrated description of the heating arrangements on "Roundtop Farm," the country seat of F. P. Olcott, near Bernardsville, N. J. 600 w. Heat & Ven—Sept. 15, 1897. No. 15450.

LANDSCAPE GARDENING.

Country Places.

Harmony in Small Country Places. Editorial on the importance of harmony of general effect, with suggestions. 1500 w. Gar & For—Sept. 1, 1897. No. 15001.

Flowers.

Wild Flowers of Early September. M. G. Van Rensselaer. Interesting review of the wild flowers of this season, and their location. 1700 w. Gar & For—Sept. 15, 1897. No. 15360.

Frost.

Some Facts About Frost Prevention. M. G. Kams. An account of the frost prevention methods used in France, with explanation of how they protect. 1100 w. Gar & For—Sept. 15, 1897. No. 15361.

Native Plants.

Native Plants for Ornamental Planting. Editorial suggesting the use of native supplies for the adornment of small country places, showing that greater harmony will result. 1500 w. Gar & For—Sept. 8, 1897. No. 15232.

The Improving of Native Plants. Thomas Meehan. Tells of a collection of native plants made in 1804 or 5, many of which the Indians used as food, and suggests the study, and cultivation of plants with this end in view. 1000 w. Gar & For—Sept. 15, 1897. No. 15359.

Parks.

How Boston Has Systematized its Parks. Sylvester Baxter. A description of the system which comprises a series of public spaces, related to each other, and each possessing a marked individuality. Highest praise is given the work. 2200 w. Century Mag—Oct., 1897. No. 15642 D.

Small Parks and Public-School Play-Grounds. Jacob A. Riis. Discusses the movement to give parks and play-grounds to New York City, giving map of existing and proposed parks. 2200 w. Harper's Wk—Sept. 11, 1897. No. 15026.

Statuary and Fittings in Our Public Parks and Gardens. Reginald Bloomfield. From a paper read at the Arts and Crafts Exhibition. A criticism of the fittings and ornaments in English public parks. 900 w. Brit Arch—Sept. 10, 1897. No. 15499 A.

Tree Planting.

What Can Be Done in Nine Years. Mary C. Robbins. Showing how a small place was changed from desolation to beauty in a few years. 2000 w. Gar & For—Sept. 8, 1897. No. 15233.

PLUMBING AND GASFITTING.

Conveniences.

Public Conveniences in New York City. Illustrated description of conveniences located beneath the sidewalk. 1300 w. Eng Rec—Sept. 18, 1897. No. 15468.

Country Residence.

Water Supply, Plumbing and Drainage System for a Country House. Illustrated description of work carried out at the country residence of Perry Tiffany, at Westbury, Long Island. 2000 w. Eng Rec—Aug. 28, 1897. No. 14981.

Hot-Water Plumbing.

Hot-Water Plumbing System in a Plainfield Residence. An unusual distribution required to supply four bath rooms on opposite sides of the house in the upper stories, beside toilet room and the usual kitchen and laundry fixtures. Ill. 700 w. Eng Rec—Sept. 11, 1897. No. 15331.

Plumbing.

Plumbing on the Pacific Coast J. L. E. Firmin. A report of methods used in San Francisco, with comparison with eastern practice. 2500 w. Dom Engng—Sept., 1897. Serial. 1st part. No. 15500 C.

Plumbing Regulations.

New York City Amended Plumbing Regulations. Full text of the regulations recently adopted by the New York Building Department. 6000 w. San Plumb—Sept. 15, 1897. No. 15503.

Sanitary Progress.

The Influence of the National Association of Master Plumbers and its Results. W. F. Taaffe. Reviews the results of the past fifteen years. 1800 w. San Plumb—Sept. 15, 1897. No. 15502.

Siphons.

Something About the Siphon. Paul Plimton. An explanation of the principle upon which the siphon acts, with illustrations of its application, &c. 1200 w. San Plumb—Sept. 1, 1897. No. 15005.

MISCELLANY.

Church Restoration.

The Restoration of Ancient Churches. From the *Church Times*. Suggestions and precautions given in the hope that they may assist in the preservation of what is left of good old work. 3000 w. Arch Lond—Sept. 10, 1897. No. 15447 A.

Columbia Library.

Architecture and Mural Painting. Charles H. Coffin. Brief description with illustrations of interior of Columbia College library, and description of the mural paintings of the Art Gallery of Bowdoin College. 1600 w. Harper's Wk.—Sept. 25, 1897. No. 15506.

Competitions.

Competitions. Barr Ferree. The first of a series of papers inquiring into the cause of competitions not turning out fairly, and studying the proposed remedies. The present number is introductory. Am Arch—Sept. 4, 1897. Serial. 1st part. No. 15226.

The Harrisburg Competition. A Record. The particulars relating to the competition for the selection of an architect for a new Capitol building, at Harrisburg, Pa., and the rejection of the report of the Board of Experts, with editorial comment. 6800 w. Arch & Build—Sept. 18, 1897. No. 15439.

The Reasonable Principles of Architectural Competition. Robert D. Andrews. Considers the four issues of importance to be first, the legal validity of the contract; second, the financial considerations; third, other considerations; fourth, demands regarding cost and accomodation, and discusses these points. 2500 w. Br Build—Sept., 1897. No. 15616 C.

Crystal Palace.

The Crystal Palace. Illustrated description of the beautiful, interesting and educational features of this institution. 5000 w. Ill Car & Build—Sept. 3, 1897. No. 15296 A.

Exhibition.

The Stockholm Exhibition. Describes the exhibition, giving illustration of grounds, and high praise of the buildings and exhibits. 1800 w. Sci Am Sup—Sept. 4, 1897. No. 15011.

The Preliminary Work of the Exposition. (Les Premiers Travaux de l'Exposition.) Giving illustrations of the present condition of the work on the Champs-Elysées and notes concerning the general progress of the various portions of the Paris exposition of 1900. 3000 w. Le Génie Civil—June 5, 1897. No. 15146 D.

A Visit to the Works of the Exposition. (Une Visite aux Chantiers de l'Exposition.) Describing the present condition of the work upon the Paris exposition of 1900. 1800 w. La Revue Technique—August 25, 1897. No. 15124 D.

Fireproof Buildings.

Can Buildings Be Made Fireproof? Corydon T. Purdy. Relates in brief the incident of the Pittsburg fire, describes the important characteristics of the construction, and points out the lessons. Ill. 7500 w. Pro Am Soc of Civ Engs—Sept., 1897. No. 15538 F.

Details of Fire-proof Construction with Burned Clay. Peter B. Wight. Illustrations with description of hollow-tile building blocks used for partitions and the setting of them. 1600 w. Br Build—Sept., 1897. Serial. 1st part. No. 15617 C.

Floor Test.

Comparative Standard Fireproof Floor Test of the New York Building Department. Part first deals with the introductory history, conditions and purposes, previous tests, kilns, and requirements of building, loading, firing, and quenching, and the Rapp system. Ill. 4000 w. Eng Rec—Sept. 18, 1897. Serial. 1st part. No. 15467.

Friezes.

The Treatment of Friezes. Walter J. Pearce. Advocates the special designing for the position and gives suggestions for the work. Ill. 2000 w. Plumb & Dec—Sept. 1, 1897. No. 15283 A.

Pueblo Buildings.

House Building by Ritual. Cosmos Mindeleff. Illustrated description of the houses built by the pueblo tribes of Arizona and New Mexico, with account of their customs. 2000 w. Sci Am—Sept. 4, 1897. No. 15009.

Ireland.

The Ancient Architecture of Ireland: Considered Especially in Relation to Pre-conquest Buildings in England. Baldwin Brown. The first of a series of papers on early Irish buildings. Ill. 2800 w. Builder—Sept. 18, 1897. Serial. 1st part. No. 15591 A.

Iron Preservation.

The Preservation of Iron in Building Structures. H. C. Standage. Discusses the various pigments used, and why they fail; states that when glycerine is present the paint cannot be a perfect protection, and gives directions for forming a desirable covering. 4000 w. Builder—Sept. 11, 1897. No. 15490 A.

Iron Work.

Report Upon the Condition of the Iron Work in the Old United States Post-Office and Custom-House Building in the City of Chicago. The conclusion of the committee is that iron properly painted before being placed in a building, and reasonably protected from air and moisture, does not deteriorate to any serious extent. Discussion. 1200 w. Jour of W Soc of Engs—Aug., 1897. No. 15609 D.

Licensing.

Licensing Architects. A series of letters from architects giving their reasons for supporting or opposing the proposed movement, with a copy of the bill which has become a law in the State of Illinois. 4800 w. Am Arch—Sept. 18, 1897. No. 15451.

Monument.

The Monument to Colonel R. G. Shaw. Illustrated account, with criticism of this monument recently unveiled in Boston. 2700 w. Am Arch—Sept. 11, 1897. No. 15324.

Nottingham.

The Architecture of Our Large Provincial Towns. Description, with illustrations, of interesting English architectural work. 3000 w. Builder —Aug. 28, 1897. No. 15090 A.

Plastering.

A Plasterer on his Craft. Editorial review of a book by William Millar—A Practical Treatise on the Art and Craft of Plastering and Modelling. 2800 w. Builder—Sept. 18, 1897. No. 15590 A.

Roman Orders.

Roman Orders of Architecture. Cyrus K. Porter. Considers the important changes in the details made by the Roman architects and artisans in their treatment of the Tuscan and Grecian orders; also the use of the arch as practiced by the Romans. 6200 w. Stone—Sept., 1897. No. 15405 C.

St. Mary's, Oxford.

The Church of St. Mary the Virgin, Oxford. Review of Book by T. G. Jackson, dealing with its historical and architectural points of interest. Ill. 4800 w. Builder—Sept. 11, 1897. No. 15489 A.

CIVIL ENGINEERING.

BRIDGES.

Accident.

The Accident of the Adour Bridge. (L'Accident du Pont de l'Adour.) P. Crépy. A discussion of the failure of a plate girder bridge under a test load of two locomotives, just after completion. 2000 w. La Revue Technique—August 10, 1897. No. 15115 D.

Berne.

The Competition for a Bridge over the Aar between Berne and the Lorraine Suburb. (Der Wettbewerb eines Aare Ueberganges von der Stadt Bern nach dem Lorraine-quartier.) With reproductions of the prize-winning designs for this important structure. Four articles. Four plates. 7000 w. Schweizerische Bauzeitung—August 14, 21, 28, September 4, 1897. No. 15130 H.

Bridge Design.

Bridge Over Wissahickon Creek, Fairmount Park, Philadelphia. Joseph Wood Wagner. Description, with illustration, of a bridge of excellent design, and well suited to the location. 1200 w. Eng News—Sept. 9, 1897. No. 15269.

Bridge Painting.

Painting the Louisville and Jeffersonville Bridge. O. E. Selby. During the painting of this bridge by the company a careful record was kept of the cost of labor and materials for different parts of the work, and the purpose of the paper is to give an analysis of the results obtained and such data as may be of value. 2200 w. Pro Am Soc of Civ Engs—Sept., 1897. No. 15537 F.

Brooklyn Bridge.

See same title under Street and Electric Railways.

Cantilever.

The Francis Joseph Bridge across the Danube at Budapest. (Le Pont François Joseph sur le Danube à Budapest.) An illustrated description of this fine cantilever, with photographic views of the partially completed work and a plate of details. 4500 w. Le Génie Civil—May 8, 1897. No 15135 D.

Cleaning Iron.

Cleaning a Viaduct by the Sand Blast. Illustrated description of the test work under the direction of E. P. North, made on the One-hundred and fifty-fifth street viaduct, New York. 1800 w. Eng Rec—Sept. 25, 1897. No. 15584.

Cleaning Structural Iron by the Sand-Blast Preparatory to Painting. An account of experimental work being conducted by the Department of Public Works, on the 155th St viaduct in New York City, which has been attacked by rust. 1500 w. Eng News—Sept. 23, 1897. No. 15533.

The Sandblast for Structural Steel. Describes the work being done on the 155th St. viaduct, its effect upon the iron, and the treatment as a test of the best protective paint. 1700 w. Am Mach—Sept. 30, 1897. No. 15624.

Corrosion.

See same title under Mining and Metallurgy Iron and Steel.

Delaware Bridge.

Superstructure of the Delaware-River Bridge at Bridesburg, Philadelphia, for Pennsylvania and New Jersey R. R. Co. Paul L. Wolfel. Detailed description and account of erection, with illustration and short discussion. 4500 w. Pro Engs' Club of Phila—July-Sept., 1897. No. 15250 D.

Drawbridge.

Operating Machinery for the North Halsted Street Drawbridge, Chicago, Ill. Illustrated description of such details of this bridge as are deserving of especial mention. 1600 w. Eng News—Sept. 9, 1897. No. 15273.

The Hydraulic Installation of the Swing Bridge at the New Harbor at Lübeck. (Die Hydraulische Einrichtung für die Drehbrücke im Neuen Hafen zu Lübeck.) Giving a full description of the very complete hydraulic machinery for turning the swing bridge, with plate of detail drawings of accumulators. 2500 w. Zeitschr Ver Deutscher Ing—September 4, 1897. No. 15111 D.

Duluth-Superior Bridge.

Duluth-Superior Bridge. Illustrated description of this bridge which was built under special act of the American congress. 2200 w. Ry Rev—Sept. 4, 1897. No. 15216.

East River Bridge.

The Anchorages for the New East River Bridge. Drawings of the general details of the Brooklyn anchorage, with description. The New York anchorage will be mostly the same; the exceptions are noted. 2200 w. Eng News—Sept. 9, 1897. No. 15274.

Enlarging Bridge.

Enlarging the Covington and Cincinnati Suspension Bridge. H. L. Bridwell. Illustrated description of a difficult piece of engineering work, which has had to be carried on without interrupting traffic. 1200 w. R R Gaz—Sept. 17, 1897. No. 15412.

Harlem River Bridge.

The Willis Avenue Bridge Over the Harlem River, New York City. Elevation with brief description of bridge to be constructed. 700 w. Eng News—Sept. 23, 1897. No. 15532.

Niagara Bridge.

Test of the New Steel Bridge at Niagara. Diagrams of deflection under test load of 2300 tons are given, with information of test. 700 w. R R Gaz—Sept. 3, 1897. No. 15031.

Paris.

The Alexander III Bridge. (Le Pont Alexandre III.) Illustrated description of this fine new single arch over the Seine, with perspective drawing, photographs of the present condition of the work, and plate of elevation and details. 5000 w. 1 plate. Le Génie Civil—June 26, 1897. No. 15155 D.

Pinion Brackets.

Improved Drawbridge Pinion Brackets. Illustrations of a steel pinion bracket recently designed by Mr. Roemheld, engineer of bridges, Chicago. 250 w. Eng Rec—Sept. 25, 1897. No. 15585.

Stephenson Bridge.

The Stephenson Bridge in Paris. Brief illustrated description of a single-span bridge which was thrown bodily across the line of the Northern Railway Co. 450 w. Engr, Lond—Sept. 3, 1897. No. 15343 A.

Versam Bridge.

The Versam Bridge. S. Berg. Illustrated description of construction of a three hinged arch bridge crossing a wild gorge. 900 w. Engr, Lond—Aug. 27, 1897. No. 15087 A.

Victoria Bridge.

The Victoria Bridge, Brisbane. Description with photographs of the bridge completed and in course of construction. 1000 w. Engr, Lond—Sept. 17, 1897. No. 15548 A.

CANALS, RIVERS AND HARBORS.

Canal.

Project for a Russian Ship Canal between Riga and Kherson. (Project für einen Russischen Seeschiffahrts-Canal Riga-Kherson.) A plan to connect the Black Sea with the Baltic by means of a ship canal in connection with the rivers Düna, Beresina and Dneiper. 1500 w. Zeitschr d Oesterr Ing u Arch Ver—August 13, 1897. No. 15127 B.

The Chicago Main Drainage Channel. J. F. Lewis. Geological evidences that the valley being opened for drainage, is connected with the processes and effects of the ice period, and is the renewing of a drainage direction which formerly existed. Also a brief description of the work on each section. Ill. 8800 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15396 D.

The Improvement of the Waterway around Douay. (Derivation de la Scarpe Autour de Douai.) Describing the improvements in the connecting canal which unites the canals of Haute-Deule and Sensée, with profile, sections, and plans of locks. 4000 w. 1 plate. Le Génie Civil—June 19, 1897. No. 15154 D.

The New York State Canals Improvement. Part first treats of the purpose and nature of the improvements, giving table of contract prices for principal items of work, and profile from Buffalo to Albany. 2000 w. Eng News—Sept. 2, 1897. Serial. 1st part. No. 15018.

Central American Canals.

The Diplomacy of the United States in Regard to Central American Canals. James Gustavus Whiteley. Historical review of the interoceanic canal problem. 5500 w. N Am Rev—Sept., 1897. No. 14991 D.

Cherbourg.

The Reinforcement Works of the Forts of the Dyke of Cherbourg. (Travaux de Renforcement des Forts de la Digue de Cherbourg.) An illustrated account of this important piece of masonry construction. 2000 w. Le Génie Civil—May 22, 1897. No. 15143 D.

Dam.

The Failure of the Bouzey Dam. Editorial on the results of the official inquiry into the cause of the failure. 2000 w. Eng, Lond—Sept. 10, 1897. No. 15438 A.

The Failure of the Bouzey Dam. (Rupture de la Digue de Bouzey.) A. Dumas. A discussion of the testimony before the French Courts, showing the failure to have been due to defective design and construction. Three articles. 9000 w. Le Génie Civil—July 10, 17, 24, 1897. No. 15164 H.

The Use of Rolling Shutters in Movable Dams. (Emploi de Vannettes a Galets pour la fermeture des Barrages Mobiles.) Description of the Boulé improved movable dam, in which the sections are carried on rollers provided with ball bearings. 3000 w. Le Génie Civil—May 1, 1897. No. 15134 D.

Dikes.

The System of Protection of Corning, N. Y., from Floods in the Chemung River. Describes the location of the city and the earthen dykes used to confine the river, giving extracts from the specifications which explain the method of construction. Ill. 2500 w. Eng News—Sept. 2, 1897. No. 15014.

Floating Dock.

Floating Dock for San Paulo de Loanda. Gives illustrated description of a steel dock recently constructed by order of the Portuguese government. 1800 w. Engng—Sept. 10, 1897. No. 15459 A.

Haulage.

Electric Towage on Canals. The first of a series of articles on this subject, dealing with chain haulage boats. Ill. 2500 w. Engng—Aug. 27, 1897. Serial. 1st part. No. 15077 A.

Levees.

The Mississippi Levees and the Flood. Extracts from a letter by H. B. Richardson, chief state engineer of Louisiana, reviewing the experience with the levees during the recent flood. 2200 w. R R Gaz—Sept. 3, 1897. No. 15033.

Lighthouses.

An Account of the French Lighthouse System. (Die Entwicklung des Französischen Leuchtfeuerwesens.) Commenting most favorably upon the administration of the French lighthouse system, and describing in detail the arrangements of arc electric lights and Fresnel prisms. 2500 w. Zeitschr d Ver Deutscher Ing—August 28, 1897. No. 15110 D.

Lock.

A New Thames Lock. Describes the condition of the Thames, the improvements already made and their effects, as well as proposed improvements, &c. 2200 w. Engng—Sept. 10, 1897. No. 15463 A.

Ports.

The Rival Ports of Monte Video and Buenos Ayres. Deals mainly with Monte Video, the position of the port and the new works. Discusses also the competition of foreign nations with British trade. Report of the British Consul. 1700 w. Trans—Sept. 10, 1897. No. 15505 A.

Wharf Improvements.

Modern Wharf Improvements and Port Facilities. Foster Crowell. Contrasting the effects of private enterprise and those of political blight upon the water-fronts of typical Atlantic cities. Ill. 4500 w. Eng Mag—Oct., 1897. Serial. 1st part. No. 15631 B.

IRRIGATION.

Irrigating Dam.

The Hemet Irrigating Dam, Southern California. Particulars from a paper by James E. Schuyler read before the Technical Society of San Francisco. Illustrated description of an interesting piece of work. 900 w. Sci Am—Sept. 25, 1897. No. 15515.

India.

Irrigation in India. Russick Loul Roy. Discusses the need of improving the water supply for irrigation purposes, reviews the different districts, what has already been done and the results. 1600 w. Ind Engng—Aug. 14, 1897. No. 15285 D.

MISCELLANY.

Address.

The Civil Engineer and the University. George S. Morison. Abstract of an address delivered at the commencement exercises of Rensselaer Polytechnic Inst., Troy, N. Y. 3000 w. Eng Rec—Aug. 28, 1897. No. 14978.

Elasticity.

The Bending Elasticity of Bodies of Unequal Resistance. (Die Biegungselastizität bei Körpern von Ungleicher Festigkeit.) R. Latowsky. Discussing the shifting of the neutral axis in bodies of different resistance to extension and compression. 3000 w. Zeitschr d Ver Deutscher Ing—August 14, 1897. No. 15102 D.

Engineering Esthetics.

The Esthetic Treatment of Engineering Work. H. Heathcote Statham. Showing the undesirability of tawdry ornament in huge engineering structures. 3300 w. Eng Mag—Oct., 1897. No. 15638 B.

Madagascar.

Engineering in Madagascar. A brief account of the exploring operations of an expedition, the difficulties, accidents and delays. 1700 w. Eng, Lond—Aug. 27, 1897. No. 15085 A.

Materials.

The Chemistry of Materials of Engineering. A. H. Sexton. The first of a series of articles in which it is intended to discuss the chemistry of the various materials used in engineering, as far as this is of importance to the engineer. The present number begins the discussion of metallic materials. 2500 w. Prac Eng—Sept. 3, 1897. No. 15323 A.

Moment of Inertia.

Computation of Statical and Inertia Moments of Rolled Sections. (Zur Berechnung von Statischen und Trägheits-momenten von Walzprofilen.) Giving the formulas for a number of the more usual sections with tables of numerical values. 1500 w. Zeitschr d Ver Deutscher Ing—August 21, 1897. No. 15106 D.

Mortar.

Hardening and Deterioration of Lime Mortar H. K. Landis. An explanation of the changes that take place in mortars, the cause of deterioration, and other effects. 1500 w. Br Build—Sept., 1897. No. 15618 C.

Limestone Screenings in Cement Mortar. Arthur N. Talbot. Report of a series of tests made by request. Followed by discussion by Alfred Noble and others. 7500 w. Jour of W Soc of Engs—Aug., 1897. No. 15608 D.

Perronet.

The Life and Works of Perronet. (La Vie et les Travaux de Perronet.) An account of the unveiling of the statue of the great French engineer at Neuilly-sur-Seine, with a biographical notice, and illustrations of the Bridge of Neuilly and other of his works. 5000 w. Le Génie Civil—July 17, 1897. No. 15165 D.

Tunnel.

An Irish Channel Tunnel. James Barton. Brief paper read before the Federated Inst. of Min. Eng. Discusses the route desirable, the geological formation, and the ventilation. 1200 w. Col Guard—Sept. 17, 1897. No. 15561 A.

ECONOMICS AND INDUSTRY.

COMMERCE AND TRADE.

British Trade.

Colonial Trade. Editorial discussion of blue-book recently issued by the Colonial Office. Considers some of the details of the report, with the general conclusion that the outlook is not very reassuring. 2300 w. Engng—Sept. 17, 1897. No. 15554 A.

China.

Opening for American Enterprise in China. A communication from Messrs. Taylor & Co., of Tientsin, speaking favorably of the opportunities for doing business in machinery and railway materials. 900 w. Cons Repts—Oct., 1897. No. 15390 D.

Commercial Museum.

An Asiatic Commercial Museum at San Francisco. A statement of the plan of John Barrett, United States Minister at Bangkok, Siam, for the establishment of a commercial museum for the purpose of bringing the immense markets of the Asian-Pacific into close touch with the United States, and furnishing a means of securipg all kinds of information in regard to the far East. 1300 w. Bd of Trd Jour—Sept. 1897. No. 15544 A.

Commerce.

America's Progress in Manufactures. A study of the American Exports and Imports. 1400 w. Engng—Sept. 3, 1897. No. 15340 A.

British Treaties of Commerce Denounced. Translation of an article which appeared in the official paper of Belgium giving notice of an official communication denouncing the treaty of commerce and navigation concluded in 1862 between Belgium and Great Britain. 2000 w. Cons Repts—Oct., 1897. No. 15300 D.

Great Britain in Russia. Discusses the commercial and industrial warfare being waged, and the efforts of Great Britain to secure some of the trade which Germany is expected to lose. 800 w. Bradstreet's—Sept. 18, 1897. No. 15415.

Our Trade with Germany and Belgium. M. G. Mulhall. Discussion of the denunciation of the commercial treaties that existed between the countries named and Great Britain, with conclusions. 1700 w. Contemporary Rev—Sept., 1897. No. 15380 D.

Contracts.

The Right of Contract. F. B. Thurber. Discussion of whether regulation of trade is "restraint of trade" in a legal sense, and showing the danger of going too far in condemning aggregations of capital. 4000 w. N Am Rev—Sept., 1897. No. 14988 D.

Discriminating Duty.

Discriminating Duty Question Decided. Editorial comment on the opinion of Attorney-General McKenna on this question. Briefly states the specific questions upon which an interpretation was requested. 1300 w. Bradstreet's—Sept. 25, 1897. No. 15570.

Eastern Trade.

A New Business Alliance. Charles Moreau Harger. Calling attention to the new trade relations of the west and northwest, which are greatly affecting the traffic of the Atlantic slope in the United States. 1800 w. N Am Rev—Aug., 1897. No. 14992 D.

Formosa.

Japan and Formosa. Criticism of the Japanese administration of the island, with extracts from the report of the British consul regarding the trade and industries. 1700 w. Engng—Sept. 10, 1897. No. 15464 A.

Germany.

The Foreign Trade and Industries of Germany. Report in detail of the continued commercial and industrial prosperity, with suggestions for extending the American trade. 3800 w. Cons Repts—Oct., 1897. No. 15391 D.

Iron and Steel Industry.

See same title under Mining and Metallurgy, Iron and Steel.

Machinery Trade.

How to Develop Our Machinery Trade Abroad. Charles Davis. Discussion of the question with suggestions. 1500 w. Mach N Y—Sept., 1897. No. 15094.

Possible Outlets for American Machinery. A. F. Tennille. Call attention of American manufacturers to new enterprises, when opportunities for trade may be looked for. 600 w. Am Mach—Sept. 16, 1897. No. 15371.

Ports.

See same title under Marine Engineering.

Prices.

Comparative Prices of 108 Staple Articles, Raw and Manufactured Products, Cattle and Meats, at Quarterly and Monthly Intervals, Showing Fluctuations in Quotations from Oct. 1, 1893 to Sept. 1, 1897, Covering the Period of Recent Extreme Depression. Table. Bradstreet's—Sept. 11, 1897. No. 15319.

Protectionists.

Two Great Protectionists—Oliver Cromwell and Bishop Berkeley. Brief review of the protective measures advocated and enforced by the men named. 1200 w. Bul of Am Ir & St Assn—Sept. 10, 1897. No. 15320.

Shanghai.

The Trade of Shanghai in 1896. Facts and figures from the report of Consul-General Hannen, which show that Great Britain is still predominant in the carrying trade, and giving information of the exports and imports, and a short account of the growth of the industries. 2000 w. Engng—Sept. 3. 1897. No. 15339 A.

Tariff.

New Tariff Law of Venezuela. Consular report giving translation showing the difference between the old and new law. 500 w. Cons Repts—Oct., 1897. No. 15284 D.

New Tariff of Japan. Translation of the tariff law, regulating the customs dues to be levied in all cases wherein Japan is not bound by treaty stipulations. 5000 w. Cons Repts—Sept., 1897. No. 15058 D.

Tariff Changes and Customs Regulations. Reports of Norway, Netherlands, Belgium, Congo State, Germany, Tunis, Dahomey, Tahiti, Philippines, Italy, Hungary, Greece, United States, Venezuela, Peru, Liberia, Formosa, Newfoundland and Natal. 7800 w. Bd of Trd Jour—Sept., 1897. No. 15545 A.

Tariff of Canada, 1897. The text of the new Canadian tariff, with index, as issued from the Customs Department, Ottawa, June 29, 1897. 55000 w. Cons Repts—Oct., 1897. No. 15299 D.

CURRENCY AND FINANCE.

Coinage.

Spanish Experiments in Coinage. Henry Charles Lea. Historical account of the vicious currency legislation and its disastrous effects. 7000 w. Pop Sci M—Sept., 1897. No. 14993 D.

Currency Legislation.

See same title under Governmental Control.

Foreign Coins.

Values of Foreign Coins and Currencies. Statements showing the value of foreign coins, as given by the Director of the United States Mint. 1500 w. Cons Repts—Sept., 1897. No. 15054 D.

Fiatism.

Lessons from History. W. M. Beckner. Experience of fiatism in New England. 2000 w. Mfrs Rec—Sept. 3, 1897. No. 15004.

Money.

The Stock of Money. Interesting informa-

tion with tabular statements showing the monetary systems of population and the approximate stocks of money in the different countries of the world in the year 1896, and showing that the amount of money in the United States has more than kept pace with the growth of population. 2500 w. Bankers' Mag, Lond—Sept., 1897. No. 15240 D.

Precious Metals.

Production of the Precious Metals. An argument for the free coinage of silver by Francis B. Forbes, with reply by David L. Webster, and editorial comment. 6000 w. Gunton's Mag—Sept., 1897. No 15244 C.

Silver.

Sinking Silver. W. R. Lawson. A discussion of the silver problem and its effect on the various countries. 7000 w. Contemporary Rev—Sept., 1897. No. 15381 D.

GOVERNMENT CONTROL.

Currency Legislation.

The Adoption of the Gold Standard by Japan. Gives briefly the history of the evolution of the gold standard, with reasons for the change in Japan. 1000 w. Bankers' Mag, N Y—Sept., 1897. No. 15387 D.

The Need of Currency Legislation. James H. Eckels. Address before the Bankers' Assn. Thinks it imperative that legislative action establish, the fact that the United States is a gold-standard country. 4200 w. Bankers' Mag, N Y—Sept., 1897. No. 15385 D.

What Legislation is Needed in Respect to the Currency. John P. Branch. Recommends the adoption of the gold standard in the United States, gradual cancellation of government demand notes, and repeal of the tax on the circulation of banks. Presented before the American Bankers' Assn. 1500 w. Bankers' Mag, N Y—Sept., 1897. No. 15386 D.

Factory Legislation.

Factory Legislation for Women in the United States. Annie Marion MacLean. Reviews the development of the factory system, the beginning of the labor legislation, discusses the laws in the various States, the general results and needs of the future. Am Jour of Sociology—Sept., 1897. No. 15382 D.

Trusts.

Trusts in Austria. A copy of the bill recently introduced in the Reichstag for the supervision of trusts controlling the price of sugar, brandy, beer, oil from minerals, salt, and such articles of consumption as are subjected to an excise. 1500 w. Cons Repts—Sept., 1897. No. 15056 D.

LABOR.

Belgium.

Work and Wages in Belgium. W. H. T. A few particulars of the hours of labor and rate of wages of fitters, machinists, &c. 800 w. Prac Eng—Aug. 20, 1897. No. 14974 A.

Child Workers.

Little Girls in Factories. Florence Kelly. Suggestions from the chief inspector of factories and workshops for the State of Illinois, as to the best means of reducing child labor, and calling attention to the conditions that exist at present. 1500 w. Chau—Oct., 1897. No. 15607 C.

Coercion.

The Case of Allen v. Flood. From the London *Times*. A summary of the judges' opinions, the facts of the case and the point of law raised by the appeal are stated by one of the judges. 9500 w. Col Guard—Sept. 10, 1897. No. 15456 A.

Compensation Act.

The Workmen's Compensation Act. Charles H. Grinling. Considers the important change which has been brought about by the passing of this act. 4000 w. Bankers' Mag, Lond—Sept., 1897. No. 15241 D.

Labor Experiment.

A Successful Labor Experiment. A sketch of the "Committee of Forty one" and "Board of Conference" established by Commissioner George E. Waring in connection with the New York Department of Street Cleaning. 4000 w. Gunton's Mag—Sept., 1897. No. 15243 C.

Recent Socialistic Experiments. Gives report of various experiments, showing that nowhere has it yet been proved possible to successfully conduct a system which dispenses with the sentiment of self-interest. 2700 w. Gunton's Mag—Sept., 1897. No. 15245 C.

Labor Insurance.

Results of German Labor Insurance. Comment on report of J. C. Monaghan, United States Consul at Chemnitz, Germany, describing the results of the German experiment. 2000 w. Gunton's Mag—Sept., 1897. No. 15246 C.

Machine Mining.

Machine Mining and the Labor Question. W. E. Garforth. A letter of interest to those who are connected with collieries working thin seams of coal. Labor troubles in England. 2500 w. Col Guard—Sept. 10, 1897. No. 15457 A.

Occupations.

The Mortality Statistics of the Census in Relation to Occupations. William A. King. Reviews data given in the census report on mortality and vital statistics showing the influence of occupation upon the death rate. 5400 w. Am Jour of Sociology—Sept., 1897. No. 15383 D.

Organized Labor.

Organized Labor at Home and Abroad. Discusses the present conditions in England, the development both in the United Kingdom and the United States, &c. 900 w. Bradstreet's—Sept. 18, 1897. No. 15414.

Riot.

Miners' Riot Near Hazleton. Henry Edward Rood. An account of the trouble in the anthracite coal field, with some important events not before printed. 2800 w. Harper's Wk—Oct. 2, 1897. No. 15598.

The Riot at Lattimer, Pennsylvania. An account of the clash between the sheriff and his deputies, and a mob of coal strikers. 900 w. Harper's Wk—Sept. 25, 1897. No. 15507.

Strikes.

Strikes and Picketing. Criticism of a book by W. J. Shaxby, recently published, with discussion of legal picketing. 1700 w. Jour Gas Lgt—Sept. 7, 1897. No. 15357 A.

The Buck-Jumping of Labor. W. H. Mallock. An interesting article showing that the power which labor is said to be acquiring, is of quite a different nature than what is popularly supposed and much more limited. 6000 w. Nineteenth Cent—Sept., 1897. No. 15297 D.

The Engineering Trades Dispute. Editorial discussion of the position as it affects both employers and employed. 1400 w. Prac Eng—Aug. 27, 1897. Serial. 1st part. No. 15092 A.

Unions.

Federations of Employers. Editorial on the causes that have made such a federation possible and right. 1500 w. Engng—Aug. 27, 1897. No. 15079 A.

Wages.

The Doctrine of Low Wages. Discusses the advocacy of low wages by the New York *Journal of Commerce*, combating the assumptions of that paper. 1500 w. Gunton's Mag—Sept., 1897. No. 15242 C.

Women Workers.

Are Women Hurting the Chances of Men in Business? Carroll D. Wright. Tabulated statements showing that the proportion of female workers is steadily increasing, and that while they to some extent take the place of men, more generally they are doing work formerly done by children. Law and intelligence have caused a constant decrease of child workers. 2700 w. Chau—Oct. 1897. No. 15606 C.

Workmen's Bill.

The "Conservative" Compensation (Workmen's) Bill of 1897. Theresa Londonderry. An examination of the opinions held by the various parties concerned, and a consideration of the effects of the bill. 1700 w. Nineteenth Cent—Sept., 1897. No. 15298 D.

MISCELLANY.

Causation.

The Philosophical Basis of Economics. Sidney Sherwood. A study in social causation aiming to show that the acts of men, social institutions, and social changes are the creation of the choices of individuals, governed by economic laws. 10000 w. An of Am Acad—Sept., 1897. No. 15050 G.

Centralization.

Administrative Centralization and Decentralization in England. J. T. Young. New conditions affecting administrative organization are considered, showing that there are three periods in the development in England. 6000 w. An of Am Acad—Sept., 1897. No. 15,049 G.

Education.

The Education of Engineers. G. F. Deacon. Address delivered by the president of the Section of Mechanics at the Toronto meeting of the British Assn. Interesting discussion of the best preparation for engineers. 4500 w. Arch, Lond—Aug. 27, 1897. No. 15200 A.

Farmers' Institutes.

Farmers' Institutes and Their Work. Frederic W. Taylor. An account of the work and the methods in different states. 2200 w. N Am Rev—Sept., 1897. No. 14990 D.

Patents.

The Extension of a Process Patent to Include the Product made Elsewhere. (Das für ein Ver. fahre Ertheilte Patent Erstreckt seine Wirkung auf die durch das Verfahren unmittelbar Hergestellten Erzeugnisse.) A very full discussion of the question under the German and Austrian patent law. Two articles. 9000 w. Glaser's Annalen—August 1, 15, 1897. No. 15169 G.

Prosperity.

The Return of Prosperity. Reviews the causes that have brought about what seems to promise a return of prosperity, the circumstances connected with the wheat crop in the United States being the real factor. 1500 w. Bankers' Mag, N Y—Sept., 1897. No. 15384 D.

Russian Industry.

The Industrial Awakening of the Russian Empire. F. J. Guyon. Describing Russia's material resources and the development and needs of her productive enterprises. 2700 w. Eng Mag—Oct. 1897. No. 15634 B.

Salaries.

Education and Salaries. Editorial comment on the low salaries paid to educated men in England, and the folly of under-paying. 1200 w. Prac Eng—Sept. 10, 1897. No. 15,422 A.

Technology.

The Relation between Technology and Mathematics. (Ueber die Beziehungen der Technik zur Mathematik.) An address by Prof. A. Stodola before the International Mathematical Congress of 1897, at Zurich. 3500 w. Schweizerische Bauzeitung—Sept. 4, 1897. No. 15131 B

ELECTRICAL ENGINEERING.

ELECTRO-CHEMISTRY.

Assaying.

See same title under Mining and Metallurgy, Copper.

Cathode Rays.

The Action of Cathode Rays upon Salts. (Ueber die Veränderung von Salzen durch Kathodenstrahlen.) Investigations by Dr. Abegg show that some salts which are affected by light rays are unaffected by cathode rays, and *vice versa*. 1200 w. Zeitschr für Elektrochemie—Aug. 20, 1897. No. 15184 B.

Electrochemistry.

The Ion Reactions, and their Importance in Electrochemistry. (Ueber Ionenreaktionen und ihre Bedentung für die Elektrochemie.) An address by Prof. Küster on the principles govern-

ing electrochemical reactions. 5000 w. Zeitschr für Elektrochemie—Aug. 20, 1897. No. 15182 B.

Electrolysis.

The Electrolysis of the Alkali Salts of Fatty Acids. (Der Elektrolyse Fettsaurer Alkalisalze.) Investigating the phenomena of the electrolytic action and the resulting products. 2500 w. Zeitschr für Elektrochemie—Aug. 20, 1897. No. 15185 B.

Electrosynthesis.

On Electrosynthesis. W. G. Mixter. Abstract from the *American Journal of Science*, July, 1897. A study of chemical union effected by electricity. 1000 w. Elect'n—Aug. 27, 1897. No. 15212 A.

Galvanizing.

The Electric Galvanizing of Iron. (La Galvanization Electrique de Fer.) Describing the methods of Dr. Wagner, and of Cowper Coles, both of these being in successful practical operation. 3000 w. Le Génie Civil—May 15, 1897. No. 15141 D.

Iodoform.

The Electrolytic Production of Iodoform. (Ueber die Elektrolytische Darstellung des Jodoforms.) Giving details of researches into the conditions of current and temperature for the best results. 4500 w. Zeitschr für Elektrochemie—Aug. 20, 1897. No. 15183 B.

Metallurgy.

Electricity as Applied to Metallurgy. Richard Threlfall. Review of the electro-metallurgical processes, with discussion of the various applications. 16500 w. Am Min Stand—Aug. 12, 1897. No. 15416 B.

LIGHTING.

Arc Lamps.

Arc Lamps and Their Mechanism. H. Franklin Watts. Part first criticises the arc lamps now in use, and thinks they may be improved by reducing the number of parts. 2400 w. Elec Eng—Sept. 30, 1897. Serial. 1st part. No. 15613.

On a Slow Combustion Arc Lamp Suitable for Factories and Street Lighting. W. S. Squire. Read before the Soc. of Chemical Industry. Describes the mechanical construction of the Jandus lamp, and considers also the chemical side of the question. 2000 w. Sci Am Sup—Oct. 2, 1897. No. 15641.

The Enclosed Arc Lamp. W. H. Freedman, H. S. Burroughs and J. Rapaport. Results of a large number of tests are given. Tests were made upon the relation between length and voltage of arc, the regulation, life of carbons, ratio of consumption of positive and negative carbons, and the distribution of light. Ill. 5000 w. Trans Am Inst of Elec Engs—Aug. & Sept., 1897. No. 15628 D.

Arcs.

Arc Spectra. Arthur L. Foley. Abstract of a paper read before the Am. Assn. for the Advancement of Science. A photographic study of the spectra is explained. 1200 w. Elec Eng—Sept. 16, 1897. No. 15408.

Constant Potential Arc. O. M. Rau, and F. A. Vaughn. Read before the Northwestern Electrical Association at La Crosse, Wis. The advantages and disadvantages of the several types of incandescent arc light systems and the development reached. 3000 w. W Elec—Aug. 28, 1897. No. 14975.

On the Phenomenon of the Electric Arc. André Blondel. A study of the causes of the great difference of potential between the carbons. Experiments and conclusions. 1600 w. Elect'n—Sept. 3, 1897. No. 15315 A.

On the Relations Between Arc Curves and Crater Ratios with Cored Positive Carbons. Mrs. Ayrton. Abstract of a paper read before the British Assn. at Toronto. Hypothesis, with conclusions and test of their accuracy. 1300 w. Elect'n—Aug. 27, 1897. No. 15209 A.

Edison Convention.

Edison Lighting Interests. Reviews the history of the Association of Edison Illuminating Companies. 3800 w. W Elec—Sept. 11, 1897. No. 15332.

Eighteenth Convention of the Association of Edison Illuminating Companies. Address of President Insull at Niagara Falls, on Sept. 14. 2500 w. Elec Eng—Sept. 16, 1897. No. 15410.

Electrical Equipment.

See same title under Electrical Engineering, Power.

Electrical Plant.

Electricity at St. Luke's Hospital. Illustrated description of an interesting installation. 800 w. Elec Wld—Sept. 18, 1897. No. 15442.

Electric Wagon.

Electric Light Wagon. (Elektrischer Beleuchtungswagen.) Illustrated description of a neat combination of petroleum motor and dynamo, mounted on wheel and readily moved from place to place. 1000 w. Elektrotechnische Zeitschrift—August 12, 1897. No. 15175 B.

Fixtures.

The Evolution of Electric Lighting Fixtures. Richard N. Dyer. Read before the National Assn. of Gas and Electric Fixtures, Niagara Falls, Aug., 1897. A statement of the development of the electric fixtures and the combination fixtures. 2800 w. Elec Eng—Sept. 2, 1897. No. 15065.

Interior Wiring.

The Testing of Interior Wiring. Deals with the questions raised by the new rules for testing. 2400 w. Elec Rev, Lond—Sept. 10, 1897. No. 15428 A.

Rochester, N. Y.

The Electric Lighting System of Rochester, N. Y. George B. Muldour. Illustrated description of the plants of the two companies whose united work has made this one of the best lighted cities of the United States. 2500 w. Elec Eng—Sept. 30, 1897. No. 15612.

Ship Lighting.

See same title under Marine Engineering.

POWER.

Accumulators.

On the Management of Electric Accumulators. F. G. Ansell. States briefly the changes going on in the battery, and gives directions for the management and care that will insure the greatest efficiency and length of service. 2000 w. Elec Eng, Lond—Sept. 3, 1897. No. 15313 A.

Batteries.

On Some New Forms of Gas Batteries and a New Carbon Consuming Battery. Willard E. Case. Read before the Electrical section of the British Assn. for the Advancement of Science, at Toronto, Ont. A record of experimental determinations. 1200 w. Elec Rev—Sept. 1, 1897. No. 15003.

Distribution.

Economy in Distribution of Electrical Energy. Louis A. Ferguson. Discusses methods of combination of the alternating and the direct current, the former being used for transmission and the latter for distribution. Read at Niagara Falls meeting and followed by discussion. 2700 w. Elec—Sept. 15, 1897. No. 15508.

Dynamos.

How to Build a Small Alternating-Current Dynamo without Castings. Nevil Monroe Hopkins. Describes a small machine which produces a "single phase" alternating current at 110 volts pressure, and is built without patterns and castings. Ill. 4800 w. Sci Am—Sept. 11, 1897. No. 15236.

Electrical Equipment.

The Electrical Equipment of a Southern City. W. E. Boileau. Illustrated detailed description of the combined power station of the Columbus (Ga.) Railroad Company and the Brush Electric Light and Power Company. 4000 w. Elec Wld—Sept. 4, 1897. No. 15229.

Electric Power.

The Application of Electric Power on Trunk Line Railways. George Forbes. Showing that electric traction is advisable in underground railways, desert railways, and in all cases where water power is easily available or where power may be applied to every axle. 5300 w. Eng Mag—Oct., 1897. No. 15630 B.

Electric Trap.

See same title under Mechanical Engineering, Miscellany.

Elevator Signals.

Elevator Calling Signals at the New York Telephone Building. Illustrated description of the system installed, which possesses several novel features. 1000 w. Elec Wld—Sept. 4, 1897. No. 15227.

Factory.

Electric Power in the American Ordnance Company's Works, Bridgeport, Conn. Illustrated detailed description of a factory said to be the best equipped of its kind in the country. 1100 w. Elec Eng—Sept. 30, 1897. No. 15614.

Household.

Electricity in the Household. George Heli Guy. A review of the various ways in which electricity has been adapted to the needs of domestic life, adding to the beauty, comfort and protection of the home. 3000 w. Chau—Oct., 1897. No. 15604 C.

Motors.

Alternating-Current Motors to Start Under Heavy Loads. Translation of a paper read by A. Heyland at the annual meeting of the Verband Deutscher Elektrotechniker at Eisenach. Describes the principles on which the motor is built and the action, stating the advantages. 1600 w. Elec Eng, Lond—Sept. 3, 1897. No. 15312 A.

Alternating Current Motor for Heavy Initial Load. (Wechselstrommotor mit Anlauf unter Hoher Belastung.) The Heyland motor is so wound that great initial starting power is obtained, as shown by test diagrams. 2500 w. Elektrotechnische Zeitschrift—Aug. 26, 1897. No. 15178 B.

The 200 Horse Power Walker Electric Motor (Moteur Walker de 200 Chevaux.) Describing the application of the Walker Motor to cars for regular or suburban railway traffic. 3500 w. La Revue Technique—Aug. 25, 1897. No. 15120 D.

Theory of Multiphase Motors with Variable Number of Poles. (Zur Theorie der Drehstrommotorem mit Variabler Polzahl.) A graphical and analytical discussion of the theory of the Dahlander multipolar motor. 3500 w. Elektrotechnische Zeitschrift—Sept. 2, 1897. No. 15181 B.

Motor Protection.

Is the Fuse or the Circuit Breaker Best Suited for Motor Protection? Joseph Sachs. The article shows that each method has its proper place, and if their adaptation to different classes of work is understood there will be no need of controversy. 3000 w. Elec Wld—Sept. 25, 1897. No. 15578.

Niagara Power.

Diversified Uses of Electrical Power at Niagara. Extracts from a paper of Charles F. Scott, recently read before the Engineers' Club of Philadelphia. A diagram of circuits is also given. 3000 w. W Elec—Sept. 25, 1897. No. 15621.

The Installation of the Niagara Falls Power Company. Charles F. Scott. Shows something of the means which have been taken, within the last few years, for the utilization of this power, and explains the most interesting features. Ill. 6500 w. Pro Engs Club of Phila—July-Sept., 1897. No. 15249 D.

Power Plants.

Electrotechnics. (Elektrotechnik) F. Uppenborn. A valuable paper describing and illustrating some of the more recent hydraulic electric power stations of Germany and Switzerland. 6000 w. Zeitschr d Ver Deutscher Ing—Aug. 14, 1897. No. 15100 D.

The Bakersfield Power Plant. Jas. D. Schuyler. Illustrated description of a hydro-electric power plant for lighting this city and supplying electricity for power as well as light. 2500 w. Eng News—Sept. 2, 1897. No. 15017.

The Bakersfield Transmission. Illustrated description with details. 6500 w. Jour of Elec—Aug., 1897. No. 15509.

The Central Electric Power Station at Strasburg. (La Station Centrale d'Energie Electrique de Strasbourg.) A fully illustrated description of this important plant with plan of the system of distribution, and plate showing the arrangement of machinery. 3500 w. 1 plate. Le Génie Civil—May 1, 1897. No. 15132 D.

Printing.

A Modern Electrically Driven Printing Establishment. Some of the difficulties of applying the electric motor to press machinery are noted, and an illustrated description of a recent installation in the printing-rooms of M. R. O'Loughlin & Co, New York. 1500 w. Elec Wld—Sept. 25, 1897. No. 15577.

Transformers.

Design, Construction and Test of a 1250-Watt Transformer. Henry S. Carhart. Describes the construction of a transformer by two students, under the direction of the writer, in order to determine how far theory dictated correct practice. 1700 w. Elec Wld—Sept. 18, 1897. No. 15440.

Transmission.

Electric Power Transmission. Walter Dixon. Read before the Federated Inst. of Min. Engs. A brief paper calling attention to the advantages of multiphase electrical machinery, followed by discussion. 1600 w. Col Guard—Sept. 17, 1897. No. 15563 A.

Wind Power.

Electric Plant Run by Wind. From the *Philadelphia Times*. Brief description. 800 w. Elec Rev, Lond—Sept. 3, 1897. No. 15288 A.

TELEGRAPHY AND TELEPHONY.

Africa.

The Telegraphic System of French West Africa. From *L'Illustration*. An account of the difficulties in establishing the system. 1400 w. Sci Am Sup—Sept. 18, 1897. No. 15362.

Annunciator.

Improved Station Annunciator. (Der Neue Stationsanrufer.) The Wetzer annunciator enables any telegraph or other station to be called without affecting any other station in the same circuit. 1500 w. Elektrotechnische Zeitschrift—August 26, 1897. No. 15179 B.

Armatures.

On the Construction of Armature Cores. William Baxter, Jr. Directions with illustrations. 2200 w. Am Mach—Sept. 2, 1897. No. 15046.

Early Telegraphy.

The Telegraphs of the United Kingdom. Charles Knight. Notes reviewing the history of the telegraph in the United Kingdom. 1000 w. Elec Rev, Lond—Sept. 3, 1897. Serial, 1st part. No. 15287 A.

Electrophone.

The Electrophone. J. Wright. Describes the instrument and its operation, by use of which one may sit quietly at home and yet enjoy the latest comedy, opera or tragedy. 1300 w. Elec Eng, Lond—Sept. 10, 1897. No. 15498 A.

Marconi System.

Marconi Telegraphy. Abstract of the patent specification. Ill. 3500 w. Elect'n—Sept. 17, 1897. No. 15589 A.

Telegraphy Without Wires in Germany. A summary description of experiments by Marconi and by Prof. Rubens of Frankfort. 1100 w. Cons Repts—Sept., 1897. No. 15055 D.

The Trial of the Marconi Telegraph at Spezia. Report of the trials made July 11, 12, and 13, and of other work. Ill. 1700 w. Sci Am Sup—Sept. 4, 1897. No. 15010.

Montreal.

New Building and Equipment of the Bell Telephone Company, Montreal. Illustrated detailed description. 1800 w. Can Elec News—Sept., 1897. No. 15363.

Quadruplex Telegraph.

The Roberson Quadruplex Telegraph. Brief description with illustration, of a system which has given favorable results so far as tested 600 w. Elec Eng—Sept. 30, 1897. No. 15615.

Submarine Telegraphy.

Submarine Telegraphy—A New French Transatlantic Cable. Henry Haynie. A cable being laid from Orleans, Mass., in Cape Cod, to the city of Brest, in ancient Brittany, paralleling the route of the old French cable, with information of submarine work. 2800 w. Sci Am Sup—Sept. 25, 1897. No. 15516.

Telephone Exchanges.

A Method of Working Telephone Exchanges from the Electric Light Supply. C. A Smith. Suggests an efficient and economical method of changing secondary cells. Ill. 400 w. Elec Rev, Lond—Aug 27, 1897. No. 15202 A.

The Binghamton, N. Y., Telephone Exchange. Harry A Gardner. Illustrates and describes this plant, calling attention to the novel arrangement of many old and some new features in the equipment. 2700 w. Elec Eng—Sept. 23, 1897. No. 15517.

The Hartford, Conn., Exchange of the Southern New England Telephone Co. Illustrated detailed description. 1700 w. Elec Eng—Sept. 9, 1897. No. 15259.

Without Wires.

Telegraphy Without Wires in Germany. Charles de Kay. An account of experiments made in Germany and in England. 1100 w. Elec Rev—Sept. 29, 1897. No. 15601.

MISCELLANY.

Alternator.

A Universal Alternator for Laboratory Purposes. Henry S. Carhart. Read before the Am. Assn. for the Adv. of Science. Describes the machine. 800 w. Elec Eng—Sept. 16, 1897. No. 15409.

Armatures.

Right- and Left-Handed Armature Winding. C. C. Hawkins. Explains the governing principles for determining the "hand" of an armature-winding, and gives illustrated applications

to the various kinds of armatures, and directions for winding. Elect'n—Sept. 10, 1897. No. 15432 A.

Cells.

On a Simple Modification of the Board of Trade Form of the Standard Clark Cell. H. L. Callendar, and H. T. Barnes. Explains the construction of a very simple form of cell, devised by the writers, resembling the Board of Trade form, but somewhat more easily made, and also entirely free from diffusion-lag in the changes of its E. M. F., consequent upon the change of temperature. 1400 w. Elect'n—Sept. 10, 1897. No 15430 A.

The Carbon Cell. Brief description of recent experiments of Dr. Borchers made to determine whether carbon monoxid could be oxidized in an electrolytic cell with the production of current, with comment. Ill. 2000 w. Elect'n —Sept. 3, 1897. No. 15314 A.

Condenser.

Electrolytic Action and Insulation Resistance of a Commercial Condenser. Dr. K. E. Guthe. Abstract of a paper read before the Am. Assn. for the Advancement of Science, at Detroit. Describes experiments made and gives results. 1600 w. Elec Eng—Sept. 16, 1897. No. 15407.

Cranes.

Electric Cranes for Continuous Currents. (Appareils de Levage Electrique à Courants Continus.) Illustrating and describing a variety of electric cranes, principally for harbor service. Two articles. 6000 w. Le Génie Civil —May 22, 29, 1897. No. 15144 G.

Electrical Development.

Electrical Development in England and France Compared with American Practice. J. McGhie. Reports very favorably regarding these countries, while admitting that electricity is not used as freely as in the United States. 2200 w. W Elec—Sept. 4, 1897. No. 15098.

Electrical Engineering.

The Precision of Electrical Engineering. Francis B. Crocker. Inaugural address of the president at meeting of the Am. Inst. of Elec. Engs. Claims exactness and certainty for the methods of this branch of engineering and examines the grounds for this claim. 8500 w. Elec—Sept. 8, 1897. No. 15265.

Electric Heating.

Heating by Electricity. (Le Chauffage par l'Electricité.) Describing the Le Roy apparatus in which blocks of silicium are raised to a red heat by the electric current for purposes of warming or cooking. 1500 w. La Revue Technique—August 10, 1897. No. 15118 D.

See same title under Street and Electric Railways.

Electric Meters.

Some Tests on the Variation of the Constants of Electricity Supply Meters, with Temperature and with Current. G. W. Donald Ricks. Presented at the Toronto meeting of the British Assn. Describes tests made to afford a means of studying variations in the accuracy of the indications under varying conditions of temperature, current and potential difference. Ill. 7000 w. Elec Wld—Aug. 28, 1897. Serial. 1st part. No. 14965.

Electric Research.

Electric Research at Low Temperature. An abstract of five papers recently communicated to the Royal Society by Profs. Dewar and Fleming, on the dielectric constants of various substances at low temperatures. Ill. 5400 w. Elect'n—Sept. 10, 1897. No. 15431 A.

Electromagnetism.

The Calculation of Electromagnetic Attraction. (Die Berechnung der Elektro-magnetischen Zugkraft.) A mathematical investigation of a practical method of calculating the pull which an electro-magnet exerts upon its armature under various conditions. 1500 w. Elektrotechnische Zeitschrift—August 19, 1897. No. 15176 B.

Electro-Mechanics.

The Mechanics of the Principal Electrical Phenomena. (Die Mechanik der Wichtigsten Elektrischen Erscheinungen.) Explaining the fundamental conceptions in electrical action by the corresponding mechanical ideas. Two articles. 6000 w. Elektrotechnische Zeitschrift—August 26, September 2, 1897. No. 15180 E.

Electrometer.

A Highly Sensitive Quadrant Electrometer. (Ueber ein Hochempfindliches Quadrantenelektrometer.) An illustrated description of the new electrometer of Profs. Nernst and Dolezalek, with instructions as to its calibration and use. 6000 w. Elektrotechnische Zeitschrift—August 19, 1897. No. 15177 B.

Exhibition.

The Victorian Era Exhibition. Gives illustrated description of some of the electrical exhibits. 1300 w. Elec Rev, Lond—Sept. 10, 1897. No. 15429 A.

Heat Waves.

Certain Optical and Electro-Magnetic Properties of Heat-Waves of Great Wave-Length. H. Rubens and E. F. Nichols. Describes apparatus used, gives results obtained, and describes experiments. 3600 w. Phys Rev—Aug., 1897. Serial. 1st part. No. 15470 D.

Hysteresis.

A New Method of Investigating the Variations of the Magnetic Qualities of Iron with Temperature. F. H. Pitcher. Abstract of paper read at the Toronto meeting of the British Assn. Describes the method and apparatus used. 2000 w. Elec Wld—Aug. 28, 1897. No. 14966.

A Method of Determining Magnetic Hysteresis Loss in Straight Iron Strips. J. A. Fleming. Read before the Physical Society. A description of a process based upon the use of the bifilar reflecting wattmeter and which operates upon samples of iron, large or small, in the form of straight strips which are simply slipped into a long magnetized coil. 1200 w. Elec Eng, Lond—Sept. 17, 1897. Serial. 1st part. No. 15592 A.

On a New Method of Measuring Hysteresis in Iron. J. L. W. Gill. Describes instrument based upon the principle that the hysteresis loss

is, by the law of the conservation of energy, numerically equal to the resultant mechanical work expended. 1000 w. Elec Wld—Sept. 4, 1897. No. 15228.

Indicator.

Rotary Electric Indicator. (Drehfeld Fernzeiger.) Describing an electric dial indicator for use on vessels between bridge and engine room. 4000 w. Elektrotechnische Zeitschrift—August 12, 1897. No. 15174 B.

Instruction.

Instruction in Practical Electricity in Night Schools. C. Walton Swoope. Illustrated account of a school adapted to the needs of those intending to become practical workers in electricity. 1000 w. Elec Wld—Sept. 25, 1897. No. 15576.

Insulation.

Liquid Air as an Insulator. Letters from J. A. Fleming and Elihu Thomson discussing the possibilities of usefulness of this agent. 1600 w. Elec Wld—Sept. 18, 1897. No. 15441.

Kite Experiment.

Franklin's Kite Experiment with Modern Apparatus. Alexander McAdie. Gives the kite experiment as described by Franklin in 1752, and describes later experiments with modern kites. Ill. 1800 w. Ap Pop Sci M—Oct., 1897. No. 15644 D.

Lightning.

Protection Against Lightning. Philip Atkinson. Comments on the ignorance and prejudice against lightning rods, and shows how these conductors should be constructed to insure protection. 900 w. Elec Eng—Sept. 2, 1897. No. 15064.

Magnetic Materials.

Magnetic Materials for Dynamos. Curves illustrating the present position of the chief magnetic materials in the three great classes of forgings, steel castings and armature stampings, with explanations. 1200 w. Elect'n—Sept. 17, 1897. No. 15587 A.

Magnets.

The Specific Magnetic Limits of Permanent Steel Magnets. (Ueber den Specifischen Grenzmagnetismus Permanenter Stahlmagnete.) An account of experimental investigations as to the influence of temperature and vibration upon the magnetic limits of steel. Two articles. 9000 w. Elektrotechnische Zeitschrift—August 12, 19, 1897. No. 15173 E.

Resistance Coils.

Some Data on the Heating Error in Resistance Coils. Frank A. Laws. Describes experiments performed under the direction of the writer to supply important data on this subject. The results are given in the form of plots. 1100 w. Tech Quar—Sept., 1897. No. 15536 F.

Roentgen Rays.

A Summary of Roentgen Ray Theories. A Vosmaer and F. L. Ortt. Considers Röntgen rays to be nothing but discharged cathode rays, and tests the hypothesis by seeing how it will explain some of the most striking experiments and facts. 1400 w. Elec Eng—Sept. 9, 1897. Serial. 1st part. No. 15261.

An Interesting Review of X-Ray Practice. Elliott Woods. Gold-foil screen described. Many important experiments and suggestions. 2200 w. Elec Rev—Sept. 15, 1897. No. 15352.

Solarization Effects in Röntgen Ray Photographs. Wm. Lispenard Robb. Experiments made are described, which seem to prove the possibility of photographic plates becoming solarized by Röntgen rays, and showing the necessity of carefully timing exposures. Ill. 1600 w. Am Jour of Sci—Sept., 1897. No. 15053 D.

The Absorption of X-Rays. (L'Absorption des Rayons X.) Experimental investigations as to the variation of opacity of various thicknesses of different materials. 1200 w. Comptes Rendus—August 23, 1897. No. 15186 D.

Rotary Converter.

Armature Reactions in a Rotary Converter. Robert B. Owens, D. W. Hawksworth and H. W. Doubrava. Experimental study of a machine of the well-known consequent pole type, with the results. Ill. 1800 w. Trans Am Inst of Elec Engs—Aug. & Sept., 1897. No. 15629 D.

Transformers.

Iron Losses in Transformers and the Higher Harmonics in the Potential-Difference Wave. William Beckit Burnie. Criticism of statements made by C. P. Feldmann in article entitled "The Influence of the Shape of the E. M. F. Curve upon the Iron Losses of Alternating Current Transformers." 1200 w. Elect'n—Aug. 27, 1897. No. 15210 A.

Wrought Iron.

The Magnetic Properties of Annealed Wrought Iron Manufactured from the Iron Sand of New Zealand. Ernest Wilson. Describes the product, difficulties in reducing, and method of experiment, giving results. 800 w. Elect'n —Sept. 17, 1897. No. 15588 A.

MARINE ENGINEERING.

BOILERS AND ENGINES.

Cambria.

New Vessel for the Holyhead and Dublin Service. Describes a fine vessel built for use of the London and Northwestern Railway Co., recently launched from the Leven Shipyard. 1400 w. Steamship—Sept., 1897. No. 15235 A.

Danish Boats.

Danish Steam Railway Ferries and Ice-Breaking Steamers. I. C. Tuxen. Illustrated description of boats constructed to continue the traffic during the entire year, between the islands and through the drifting ice. 2000 w. Marine Engng—Sept., 1897. No. 15257 C.

Indicator.

See same title under Electrical Engineering.

Japan.

Shipping Affairs in Japan. Editorial consideration of some of the most important points in the rapid development of the mercantile marine of this country. 2500 w. Engng—Sept. 17, 1897. No. 15555 A.

Paddle Steamer.

Paddle Steamer I. Ferencz Josef. Brief description, dimensions and illustrations of Danube steamer. 900 w. Engr, Lond—Aug. 27, 1897. No. 15088 A.

Shipbuilding.

Shipbuilding and Marine Engineering on the Thames in the Victorian Era. Part first, as an introduction to the subject to be considered, reviews events preceding the present reign, the invasion of the Dutch, as recorded by Samuel Pepys, the threatened invasion of the Spaniards, &c. Ill. 3800 w. Engr, Lond—Sept. 3, 1897. Serial. 1st part. No. 15344 A.

Shipbuilding in Theory and Practice. The first of a series of articles in which it is the writer's intention to give a clear and explicit description of the calculations employed and the methods adopted in the science of shipbuilding. 900 w. Mech Wld—Sept. 3, 1897. Serial. 1st part. No. 15294 A.

Ship Lighting.

The Lighting Plant on the "Rotterdam." Illustrated description of interesting equipment, possessing some features unknown to American practice. 1000 w. Elec Wld—Sept. 11, 1897. No. 15290.

Stability.

Comparison between the Alabama and the Prince George. (Comparison entre le Cuirassé Américain Alabama et le Cuirassé Anglais Prince George.) Reviewing a discussion in the London Engineer concerning the alleged inferior stability of the American vessel. 1600 w. Le Génie Civil—July 10, 1897. No. 15163 D.

Steel Construction.

Steel Considered as a Material for Ship Construction and Machinery. C. A. McAllister. The importance of selecting and testing material. The unfitness of steel made by the Bessemer process for marine construction. The writer's preference for acid open-hearth steel, and general discussion of requirements, &c. 1600 w. Marine Engng—Sept., 1897. No. 15258 C.

Torpedo-Boats.

Our Latest Thirty-Knot Torpedo-Boats. R. G. Skerrett. Describes these boats which are really torpedo boat destroyers. 1500 w. Harper's Wk—Sept. 11, 1897. No. 15028.

Turret-Ships.

Ericsson's First Monitor and the Later Turret Ships. George L. Fowler. The evolution of a radical change in battle-ship design. Ill. 3300 w. Eng Mag—Oct., 1897. No. 15639 B.

Vibrations.

Method of Securing an Autographic Record of Steamship Vibrations. W. F. Durand. Describes instrument for automatically recording vibrations and explaines its principles. Ill. 1600 w. Marine Engng—Sept., 1897. No. 15256 C.

MECHANICAL ENGINEERING.

BOILERS, FURNACES AND FIRING.

Boiler Construction.

Materials and Tests for Boiler Construction in America. Condensed report of the committee of the American Boiler Manufacturers' Assn., presented at Philadelphia. 3000 w. Ir & St Trds Jour. Aug. 28, 1897. No. 15234 A.

Boiler Test.

Test of a Cahall Boiler. Report of George H. Barrus of a test of one of the 200-H. P. Cahall water-tube boilers at the Narragansett Mills, Fall River, Mass. Extract showing exceptionally good results. 800 w. R R Gaz—Sept. 24, 1897. No. 15530.

Condensers.

Condensers. E. J. Philip. Read before the Canadian Assn. of Stationary Engs. Explains the advantages of their use and describes several types. Also briefly discusses air pumps. 2000 w. Can Eng—Sept., 1897. No. 15325.

Efficiency.

Causes of the Variable Efficiency of Steam Boilers and Their Influence on Tests. F. G. Gasche. An account of experimental work with drawings and discussion. 6700 w. Jour of W Soc of Engs—Aug., 1897. No. 15610 D.

Failure.

Failure of an Upright Boiler. From *The Locomotive.* Describes the conditions and the cause of failure. 800 w. Engr—Sept. 4, 1897. No. 15099.

Furnace.

A Combination Retort and Reverberatory Furnace. Courtenay De Kalb. Brief illustrated description of a type of furnace possessing peculiarities intended to meet the necessities of laboratory instruction. 350 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15397 D.

Grease Extraction.

The Removal of Grease from Condensed Steam. (Entfettung des Kondensirten Abdampfes.) Describing Dehne's apparatus for filtering the grease from surface condenser water before it is returned to the boiler. 1200 w. Zeitschr d Ver Deutscher Ing—Aug. 2, 1897. No. 15104 D.

Indicators.

The Indicator. G. B. Risler. On the value of the indicator with directions for its proper use. 1500 w. Can Eng—Sept., 1897. No. 15326.

Powdered Coal.

Burning Powdered Coal Under Steam Boilers. Account of a series of experiments, recently conducted in New York, on a new method invented by Carl Wagener, a German engineer. The apparatus is described and illustrated, and

the results of the tests discussed editorially. 1600 w. Eng News—Sept. 16, 1897. No. 15378.

Purifier.

Improved Feed Water Purifier. (Neue Wasserreiniger für Kesselspeise.) Showing several forms of apparatus for purifying feed water by heating, precipitating, and filtering. 4000 w. Zeitschr d Ver Deutscher Ing—Aug. 14, 1897. No. 15103 D.

Staybolts.

The Breaking of Staybolts. A summary of the troubles, their causes and possible remedies, with suggestions that have been made. 3300 w. Am Eng & R R Jour—Sept., 1897. No. 14986 C.

Repairs.

How to Make Light Repairs on the Locomotive Boiler. Henry J. Raps. Suggestions for repairs and care. Ill. 2300 w. Loc Engng—Sept., 1897. No. 15201 C.

Safety Valve.

The Lever Safety Valve. C. A. Collett. The object of the article is to ascertain, as far as possible, to what extent the rules laid down by authors harmonize, and to enable the engineer to decide whether his safety valve is of ample capacity to relieve the boiler of an over-production of steam. 1700 w. Mech Wld—Sept. 17, 1897. No. 15541 A.

Settling Tank.

A Feed-Water Settling Tank. Walter Ferris. Describes the latest arrangement of a large iron works, for the prevention of scale and sediment in boilers. Ill. 1000 w. Am Mach—Sept. 9, 1897. No. 15262.

Superheating.

Superheated Steam. An account of the experiments carried out on a Sulzer compound-condensing steam engine in Bavaria. 1100 w. Bos Jour of Com—Sept. 11, 1897. No. 15311.

Traps.

About Steam Traps. W. H. Paine. Notes from a paper recently read before the Rhode Island. No. 2, National Assn. of Stationary Engineers of Pawtucket. Describes the trap under discussion and considers piping and connections, repairs, &c. 2000 w. Bos Jour of Com—Sept. 25, 1897. No. 15525.

Waste Heat.

Waste Heat and Gases from Coke Ovens. Charles E. Bowron. Describes how they are successfully utilized in the generation of steam by the Tennessee Coal, Iron and Railroad Company. Ill. 800 w. Col Eng—Sept., 1897. No. 15350 C.

COMPRESSED AIR.

Address.

Compressed Air: Its Production, Transmission and Use. William Prellwitz. Address delivered at Lafayette College, Easton, Pa. Discussion of the subjects named. 5500 w. Compressed Air—Sept., 1897. No. 15510.

Air-Compressor.

Corliss-Valved Air-Compressor. Herr Kaufhold. From a communication to *Glückauf*. Describes the air-compressor designed by Ferdinand Struad. There is only one air cylinder, the piston of which is driven directly off the crank-shaft. Ill. 2000 w. Col Guard—Sept. 3, 1897. No. 15336 A.

Traction.

Compressed Air Traction. A résumé of the present state of the equipment on 125th St., New York, taken from a recent publication by the American Air Power Company, with editorial. 900 w. Am Eng & R R Jour—Sept., 1897. No. 14982 C.

ENGINES AND MOTORS.

Balancing.

The Action of Masses in Crank Transmission, and their Equalization in Multiple Crank Engines. (Die Massenwirkungen am Kurbelgetriebe und ihre Ausgleichung bei Mehrkurbligen Maschinen.) A very full and valuable contribution to the study of balancing the reciprocating parts of steam engines, by Prof. Dr. Lorenz. Two articles. 9000 w. Zeitschr d Ver Deutscher Ing—August 28, September 4, 1897. No. 15109 G.

Crank Action.

The Motion of Winding Engines for Various Crank Positions. (Das Anlaufen der Fördermaschinen aus jeder Kurbelstellung.) A graphical investigation of the crank action on double cylinder engines, showing the causes for irregularity of motion. 1200 w. Zeitschr d Ver Deutscher Ing—August 21, 1897. No. 15107 D.

Fly-Wheels.

About Fly-Wheels. Their strength and how figured. 2200 w. Bos Jour of Com—Sept. 4, 1897. No. 15006.

Gas Engines.

The Cycles of Gas and Oil Engines. James D. Roots. This first of a series of articles contains a table of classification, into ten types, explanation of reasons for so classifying. 3000 w. Engr, Lond—Sept. 3, 1897. Serial. 1st part. No. 15342 A.

The Donaldson Compound Gas Engine. Illustrated description. 500 w. Elec Rev, Lond—Sept. 3, 1897. No. 15286 A.

The Gas and Petroleum Motors at the Geneva Exposition, 1896. (Die Gas und Petroleummotoren auf der Schweizerischen Landesausstellung in Genf, 1896.) Three articles containing many illustrations of the latest Continental practice and construction. 6000 w. Schweizerische Bauzeitung—August 14, 21, 28, 1897. No. 15129 G.

Heat.

A Theoretical and Practical Study of the Utilization of Heat. (Etude Theorique et Pratique de l'Utilization de la Chaleur.) A valuable series of papers by MM. Damour and Waton treating of the calorific value of combustibles and the best methods of utilizing it. Serial. Part 1, and 2. 10000 w. Le Génie Civil—May 29, & June 19, 1897. No. 15145 G.

High Speed.

High Speed Engines for Industrial Purposes. (Les Machines a Grand Vitesse dans l'Industrie.)

Describing the successful and economical performance of the Willans high speed engine in French spinning mills. 1200 w. La Revue Technique—August 10, 1897. No. 15114 D.

Knocking.

Knocking in Engines. The causes of knocks in steam spaces and the difficulty of locating them. 1400 w. Prac Eng—Aug. 20, 1897. No. 14972 A.

Motors.

See same title under Electrical Engineering, Power.

Oil Engine.

Southall's Ideal Oil Engine. Illustrated description of an engine working on the Otto cycle, and using only heavy petroleum for both starting and running. 700 w. Engr, Lond—Sept. 17, 1897. No. 15549 A.

The "Ruston" Oil Engine. Brief illustrated description. 900 w. Engng—Aug. 27, 1897. No. 15078 A.

Piston Packing.

Piston Packing Rings of Modern Steam Engines. Otto C. Reymann. Investigates how packing rings for steam engines should be designed in order to exert a certain amount of pressure upon the cylinder walls. 1700 w. Prac Eng—Aug. 20, 1897. Serial. 1st part. No. 14973 A.

POWER AND TRANSMISSION.

Elevator Accident.

Elevator Accident in the American Tract Society Building. Explains the system of elevators installed, giving description, with particulars of the accident. 2000 w. Eng Rec—Sept. 18, 1897. No. 15466.

Fall of an Elevator at the Tract Society Building, New York. Describes the type of elevator, and the accident, with illustration. 1500 w. Sci Am—Sept. 25, 1897. No. 15514.

Fall of a Passenger Elevator in New York City. Brief account of the accident at the American Tract Society Building, on Sept. 10, 1897, which caused the death of two persons. 900 w. Eng News—Sept. 16, 1897. No. 15376.

The Elevator Accident at the Tract Society Building, New York. Report of the opinion of the coroner's jury, with comments. 1200 w. Sci Am—Oct. 2, 1897. No. 15619.

The Fall of an Elevator in the Building of the American Tract Society. Illustrations showing the construction of the elevator machinery and safety appliances, with explanation, and suggestion of possible causes of the accident. 3500 w. Eng News—Sept. 23, 1897. No. 15535.

Gearing.

Researches in Worm Gearing. (Versuche mit Schneckengetrieben.) A very thorough investigation by Prof. Stribeck, showing the form and pitch adapted to give the best efficiency, with investigations as to lubrication; many diagrams. 7500 w. Two articles. Zeitschr d Ver Deutscher Ing—Aug. 14, 21, 1897. No. 15101 G.

Hydraulic Power.

Motive Power in the Maritime Alps. (Les Forces Motrices des Alpes-Maritimes.) An account of the plans to utilize the hydraulic power of the rivers Var and Cians, in the south of France. 1500 w. La Revue Technique—Aug. 25, 1897. No. 15125 D.

Power Distribution.

The Direct Distribution of Energy. Charles E. Emery. Dealing especially with plants for the distribution of steam. 4100 w. Eng Mag—Oct., 1897. No. 15637 B.

Rheinfelden.

The Utilization of the Power of the Rhine at Rheinfelden. (Utilization des Forces Motrices du Rhin à Rheinfelden.) A description of the important hydraulic and electric plant under construction on the Rhine above Basle, with photograph and drawings of the turbines and generators. Two articles. 7000 w. Le Génie Civil—July 3, 17, 1897. No. 15158 G.

Steam Economy.

Economy in the Generation and Use of Steam. W. H. Wakeman. Calls attention to some things that might be done better than they usually are, and suggests some changes. 1400 w. Mach, N Y—Sept., 1897. No. 15097.

Turbines.

A Notable Pair of Horizontal Turbines. Gives illustrated description of a powerful pair of turbines erected for the Boston and Montana Consolidated Copper and Silver Mining Company, at Great Falls, Montana. 900 w. Sci Am—Sept. 25, 1897. No. 15513.

The Turbines of Ganz & Co., at the Budapest Exposition. (Die Turbinen von Ganz & Co. auf der Millenniums-Landesausstellung zu Budapest.) With excellent illustrations of vertical and horizontal turbines and governors by this well-known firm. 5000 w. Zeitschr d Ver Deutscher Ing—Aug. 21, 1897. No. 15105 D.

Water-Wheels.

Limiting Factors in the Government or Regulation of Water Wheels. Abridged paper by Mark A. Replogle. Indicates the lines on which a water-power plant must be laid down to attain best results. 1200 w. Col Eng—Sept., 1897. No. 15349 C.

SHOP AND FOUNDRY.

American Shop.

A Modern American Shop. Description of some of the machines and operations seen during a recent visit to the works of the Mossberg & Granville Manufacturing Company. Ill. 1800 w. Mach, N. Y—Sept., 1897. No. 15095.

Bearings.

Roller Bearings. Detailed description of the exhibit of the Roller Bearings Company, of Delahay Street, Westminster, showing recent improvements, and claiming to have proved that rolling motions for bearings are now being successfully applied to the heaviest loads with satisfactory results. Ill. 1400 w. Engr, Lond—Sept. 3, 1897. No. 15345 A.

Roller Bearings. W. Bayley Marshall. Abstract of a paper read before the Toronto meeting of the British Assn. for the Advancement of Science. Presents the advantages from the use

of roller bearings, the requirements of such bearings, and some of the results obtained. 1300 w. Can Eng—Sept., 1897. No. 15327.

Brass.

The Value and Use of Aluminum, Manganese and Silicon in the Brass Foundry. F. J. Davis. From Proceedings of the American Foundrymen's Assn. Directions for the use of these metals in order to secure good results. 1300 w. Am Mach—Sept. 9, 1897. No. 15264.

Castings.

Skimming Castings. R. D. Moore. Explains the principle of skimming metal effectually, or of constructing a skim gate that will separate the dross from the pure metal. Ill. 900 w. Am Mach—Sept. 16, 1897. No. 15373.

Cost Keeping.

Cost-Keeping Methods in Machine-Shop and Foundry. Henry Roland. Dealing with the elements of cost and the influence of wage systems. 3700 w. Eng Mag—Oct., 1897. No. 15633 B.

Cranes.

See same title under Electrical Engineering, Miscellany.

Dies.

Dies for Punching Blanks for Grooved Armature Cores. William Baxter, Jr. Gives illustrated description of the forms designed by the writer for this use, with the objects sought to be accomplished. 1500 w. Am Mach—Sept. 23, 1897. No. 15524.

Facings.

The Mission of Foundry Facings. Henry Hansen. Discussion of statements made in paper by H. F. Frohman, presented before the Western Foundrymen's Assn. 1200 w. Am Mach—Sept. 2, 1897. No. 15047.

Fire Department.

A Shop Fire Department. Describes the organization of the men and their assignment to duties in case of fire in the shop of J. H. Williams & Co., of Brooklyn, N. Y., manufacturers of drop forgings. 1200 w. Am Mach—Sept. 23, 1897. No. 15523.

Flanges.

The Calculation of the Strength of Loose and Fast Flanges. (Berechnung der Festigkeit Loser und Fester Flansche.) An analytical discussion of the strength of pipe flanges, when cast in one piece with the body, and when considered separately. 6000 w. Zeitschr d Ver Deutscher Ing—Sept. 4, 1897. No. 15113 D.

Friction Wheels.

Paper Friction Wheels. M. W. Danielson. Gives results of testing eight kinds of paper friction wheels and suggests one more way of making them. 1000 w. Am Mach—Sept. 2, 1897. No. 15048.

German Shops.

German Workshops. Impressions of the writer with comments. 1600 w. Mach, N Y—Sept., 1897. No. 15096.

Isca Foundry.

The Isca Foundry at Newport, South Wales. Brief illustrated description. 900 w. Ir & Coal Trds Rev—Sept. 10, 1897. No. 15492 A.

Jigs.

The Construction of Jigs for Drilling Holes in the End Rings of Armature Cores. William Baxter, Jr. Shows the necessity for obtaining accurate spacing of the holes, and in order to secure it the need of having a jig perfectly true, and explains how to secure this accuracy. Ill. 2000 w. Am Mach—Sept. 16, 1897. No. 15372.

Molding.

The Tabor Molding Machine. Illustrated description of an improved machine, operated by compressed air. 1200 w. Am Mach—Sept. 30, 1897. No. 15622.

Rear-Fork End.

A Rear-Fork End—How to Make It. W. A. Warman. Illustrated detailed description. 600 w. Am Mach—Sept. 2, 1897. No. 15045.

Rim-Drilling.

Automatic Rim-Drilling Machine. Describes a machine designed for making wooden rims for bicycle wheels at a very rapid rate. Ill. 700 w. Am Mach—Sept. 30, 1897. No. 15623.

Shop Notes.

Some Notes from an English Shop. James Vose. Illustrated description of the works of Meldrum Bros., Manchester, Eng., with the methods and tools in use. 3000 w. Mach, N Y—Sept., 1897. No. 15093.

Taper Turning.

Taper Turning Attachments. Illustrated description of an attachment for this work. 1000 w. Ir Age—Sept. 2, 1897. No. 15060.

Tools.

The Care of Hand Saws. Julien A. Hall. Hints for keeping a saw in order. 1600 w. Ry Mas Mech—Sept., 1897. No. 15039.

The Valuation of Machine Tools. Editorial on the methods of estimating the value of machine shop equipment. 1000 w. Am Mach—Sept. 30, 1897. No. 15625.

Specification of Error Limits for Machine Tool Construction. A. A. Fuller. Discusses the importance of specifying the quality of workmanship. 1800 w. Am Mach—Sept. 16, 1897. No. 15374.

Staking Tools. A. H. Cleaves. Illustrated description of a jeweler's staking tool, with by a set of tools for various requirements. 1000 w. Am Mach—Sept. 16, 1897. No. 15370.

MISCELLANY.

Automata.

Some Remarkable Automata. W. F. Durfee. Remarks with description of three ingenious exhibits, as given in the Descriptive Inventory of James Cox, of London. 1100 w. Am Mach—Sept. 9, 1897. No. 15263.

Automobiles.

A Study of Automobile Vehicles. (Etudes sur les Automobile Vehicles.) P. Crépy. Begins with a review of the various types, discussing recent performances. Serial. Part I. 2000 w. La Revue Technique—August 25. 1897. No. 15121 D.

Electric Cabs. Description of the cabs in use in London, dealing chiefly with the internal arrangements. 2000 w. Arch, Lond—Sept. 3, 1897. No. 15309 A.

Motor Road Vehicles. Joseph Sachs. Brief review of efforts to solve this problem, and a presentation of general features needing consideration. Ill. 5000 w. Jour Fr Inst—Sept., 1897. Serial. 1st part. No. 15052 D.

The Riker Electric Trap. Illustrated description. 2000 w. Elec Wld—Sept. 4, 1897. No. 15230.

Balloon Expedition.

The Andrée Expedition. (L'Expedition Andrée.) Description, with photographs of the construction of the buildings and apparatus for inflation of the balloon of the Andrée expedition at Spitzbergen. 4500 w. Le Génie Civil—July 17, 1897. No. 15167 D.

Bicycles.

The Tuttle Chainless Bicycle. Illustrated description of a bicycle embodying unique and ingenious features. 1000 w. Ir Age—Sept. 2, 1897. No. 15059.

Cannon.

Improved Dismounting Cannon. (Nouveaux Canons Démontables.) Col. Fix. Describes the improved system of Col. Lycoudis of dismounting field pieces for use in mountainous countries. Two mules only are required instead of three as formerly. Two articles. 3500 w. La Revue Technique—August 10 and 25, 1897. No. 15119 E.

Coal Bins.

The Computation of Strains in Coal and Grain Bins. A discussion of bin pressures, computation of strains, &c. 1500 w. Eng News—Sept. 23, 1897. No. 15534.

The Design of the Coal Bin at the Paterson Electric Light Station. Letter from Messrs. Milliken Bros., the designers and builders of the coal bin that failed recently at Paterson, N. J., with editorial comment. 2000 w. Eng News—Sept. 23, 1897. No. 15531.

Cold.

Apparatus for the Production of Low Temperatures. (Machine pour l'obtention des Basses Temperatures.) An illustrated description of the Linde apparatus by which atmospheric air is frozen. Two articles. 5000 w. Le Génie Civil—May 15, 22, 1897. No. 15139 G.

Lubrication.

A Determination of the Specific Resistance and Temperature Coefficient of Oil in Thin Films, and the Application of These Results to the Measurement of the Thickness of the Oil Film in Journal Boxes. F. L. O. Wadsworth. Gives results of investigations. 4500 w. Phys Rev—Aug., 1897. No. 15469 D.

Levitation.

The Experiments of Prof. Wellner. (Experiences du Professeur Wellner.) Describing the experiments made to ascertain the levitating power of aerial screw propellers. Two sizes of propellers were driven by a stationary engine, and the lifting power measured at various speeds. 800 w. Le Génie Moderne—September 15, 1897. No. 15197 B.

Memoir.

Otto H. Mueller; His Life and Influence on Machine Construction. (Otto H. Mueller: sein Leben und seine Bedeutung für den Maschinenbau.) A very interesting account of one of the pioneers of German engineering, with early sketches of machine details, &c. 4000 w. Zeitschr d Ver Deutscher Ing—Aug. 28, 1897. No. 15108 D.

Packing.

Packing as a Product of the Rubber Factory. Gives history of the use of packing with illustrated description of types. 3300 w. Ind Rub Wld—Sept. 10, 1897. No. 15388 D.

Plumbago.

Plumbago. Editorial on the use of plumbago as a lubricator, the best form in which to apply it, scarcity of this form, &c. 1000 w. Engng—Sept. 10, 1897. No. 15462 A.

Press.

Presses for Baling Hay and Straw. (Presses pour le Foulage du Foin et de la Paille.) Illustrating and describing improved portable screw presses for agricultural purposes. 1000 w. 1 plate. Le Génie Civil—July 17, 1897. No. 15166 D.

Pump.

An Improved Pump with Constant Discharge. (Nouvelle Pompe á Débit Constant.) The Holst pump is made with a peculiar lever motion by which the plunger moves at a uniform velocity throughout the entire stroke, and two such pumps give a practically constant discharge. 2500 w. Le Génie Civil—June 12, 1897. No. 15152 D.

Scales.

Influence of the Position of Rods and Beams upon the Accuracy of Decimal Scales. (Nachweisung des Einflusses des Anzugs der Zugstangen und des Ansteigens des Unterbalkens auf die Empfindlichkeit der Decimalwaagen.) A highly mathematical treatment of the sources of error in so-called decimal weighing machines. 3500 w. Glaser's Annalen—Aug. 15, 1897. No. 15171 D.

Steam Crane.

How to Run a Steam Crane. Joseph Horner. General instructions. 1800 w. Mech Wld—Sept. 10, 1897. No. 15488 A.

Tires.

An Investigation of the Physical Properties of Compressed Iron Tires. Frederick Grover. Report of a series of tests by the writer, which led him to believe, by the results obtained, that Bauschinger's law concerning the range of elastic limit fails under extreme treatment of the specimen. Ill. 1800 w. Engr, Lond—Sept. 3, 1897. No. 15341 A.

Viscometer.

Redwood's Viscometer in Practice. H. Andrews and G. E. Brown. Practical directions for the manipulation of this instrument which will enable any one to carry out with accuracy and speed the testing of any oils from a viscosimetric point of view. 3500 w. Prac Eng—Sept. 17, 1897. No. 15593 A.

MINING AND METALLURGY.

COAL AND COKE.

Accident.

Report on the Devon Colliery Accident. Official report concerning this accident which occurred March 26, 1897. 3000 w. Col Guard—Aug. 27, 1897. No. 15084 A.

Berlin.

The Fuel Consumption of the City of Berlin in 1896. (Der Brennmaterialverbrauch in Berlin im Jahre 1896.) An interesting report on the relative proportion of various kinds of coal used, with plate showing the results graphically from 1890 to 1896. 1500 w. 1 plate. Glückauf—Aug. 28, 1897. No. 15189 B.

British Coal.

The British Coal Industry—Its Troubles and Their Remedies. Considers the movement to regulate production and prices, not only in England, but in all coal-producing countries. 3700 w. Ir & Coal Trds Rev—Sept. 10, 1897. No. 15493 A.

Bruay.

The New Works of the Mines of Bruay. (La Fosse No. 5, des Mines de Bruay.) Describes the plant installed in the new pit of the Bruay coal mines in the Pas-de-Calais district, with plate of pumping engines. 2500 w. 1 plate. La Revue Technique—Aug. 25, 1897. No. 15122 D.

Coal Cargoes.

The Dangers of Coal Cargoes. Extracts from the report of the commissioners appointed by the New South Wales Government to enquire into the cause of the dangers to which vessels carrying coal are said to be peculiarly liable, and as to the best means for removing or lessening the same. 3500 w. Col Guard—Sept. 10, 1897. No. 15455 A.

Coal-Felds.

Colonial Coalfields. Part first is confined to the fields of British Columbia, giving production, value, importance of export trade, &c. 3500 w. Ir & Coal Trds Rev—Aug. 27, 1897. Serial. 1st part. No. 15205 A.

New Coalfields. Notes on the importance of the fields in Zululand and in the United States of Colombia. 1100 w. Bd of Trd Jour—Sept., 1897. No. 15543 A.

The Geology of the Donetz Coalfield. M. Tschernyschew and L. Loutouguin. Abstract of an article describing this most important coal-producing district of Russia. 1500 w. Col Guard—Sept. 3, 1897. No. 15334 A.

Coal Formation.

The Formation of Coal and Generation of Fire Damp. M. F. Rigaud. From a communication to the *Revue Scientifique*, Paris. Part first considers the age and origin of coal deposits, ferrous central nucleus, and the carbon contribution of vegetable origin. 2500 w. Col Guard—Sept. 10, 1897. Serial. 1st part. No. 15452 A.

Coke Oven.

The Simon-Carves Coke Oven. Interesting particulars in regard to this coke-oven system for the manufacture of coke and recovery of by-products. The coal is converted into coke by heat transmitted through the oven walls. 1800 w. Col Guard—Sept. 17, 1897. No. 15559 A.

Dusty Mines.

An Unrecognized Danger in Dusty Coal Mines. James Ashworth. Showing that bonneted and other safety lamps are not a safe means of lighting coal mines where coal dust as well as fire damp is present, and the way in which such risks may be practically obviated. Ill. 7000 w. Col Guard—Sept. 3, 1897. No. 15333 A.

Early Conditions.

Slavery in the Coal Mines of Scotland. James Barrowman. Read at the Federated Inst. of Min. Engs. Early history of the industry, its connection with salt making, the conditions of labor, and the causes that led to the binding of workmen to their masters. 1800 w. Col Guard—Sept. 17, 1897. No. 15562 A.

Fifeshire.

The Methods of Working Minerals, Secondary Haulage, and Ventilation in Fifeshire. Andrew Burt. Abstract of a paper read before the Federated Inst. of Min. Engs. Early history of the mines, the present system of longwall working, the stoop and room working, &c. 5000 w. Ind & Ir—Aug. 27, 1897. No. 15089 A.

Regulation.

The Regulation of Coal Output and Prices. Part first considers the cases of the Westphalian coal trade syndicate, the New South Wales, the scheme of Sir George Elliot, of D. A. Thomas, and Sir W. T. Lewis, with further proposals. 7500 w. Ir & Coal Trds Rev—Sept. 17, 1897. Serial. 1st part. No. 15583 A.

Sale of Collieries.

The Law as to Principal and Agent for the Sale of Collieries and Coal. Brief review of cases in England. 3000 w. Col Guard—Sept. 10, 1897. No. 15453 A.

Separators.

The Development of Separating Apparatus. (Ueber die Entwickelung der Separations Apparate.) Describing and illustrating the improvements in apparatus for separating and screening coal. 2500 w. Glückauf—August 28, 1897. No. 15188 B.

Submarine Mining.

Submarine Coal Mining at Bridgeness, N. B. Henry M. Cadell. Read before the Federated Inst. of Min. Engs. Describes the formation, the difficulties met and conquered, &c. 2000 w. Col Guard—Sept. 17, 1897. No. 15560 A.

Tubbing.

Substitution of Cast Iron Tubbing for Wood in a Belgium Pit. L. Verniory. From a communication to the Assn. des Ingenieurs Sortis

de l'Ecole de Liége. Describes the modern tubbing constructed in 1848, the trouble with leakage and the replacing by iron tubbing, the water being kept back during the operation by means of a concreted plate-curve constructed under the water level. 3500 w. Col Guard—Sept. 3, 1897. Serial. 1st part. No. 15335 A.

Wallsend Colliery.

The Wallsend Colliery. Abstracted from the *Newcastle Chronicle*. An account of a visit to this colliery which has been idle for a generation on account of being flooded, and is now being put in order for further working. 2000 w. Col Guard—Aug. 27, 1897. No. 15083 A.

Washing.

Coal Washing. Charles E. Bowron. A description of the coal washing and coking plant at Tracy City, Tennessee. 1000 w. Col Eng—Sept., 1897. No. 15348 C.

COPPER.

Assaying.

The Electrolytic Assay as Applied to Refined Copper. George L. Heath. Facts that have come under the writer's notice during an extended use of the method. 3500 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15399 D.

Copper Mining.

Anaconda Copper Mining Company. Report of the trustees showing the operations of the company for the second year of its existence, with editorial analysis. 4000 w. Eng & Min Jour—Sept. 18, 1897. No. 15434.

Russia.

The Copper Industry in Russia. (L'Industrie du Cuivre en Russie.) Discussing the falling off in Russian copper production, and the possible means for its revival. 3500 w. Le Génie Civil—June 12, 1897. No. 15151 D.

GOLD AND SILVER.

Broken Hill.

Meeting of Broken Hill Proprietary Company, Limited, New South Wales. Address of chairman, Mr. E. Neale Wigg, showing what has been done during the past half year, and the plans for the future. 4400 w. Aust Min Stand—Aug. 5, 1897. No. 15356 B.

Colorado.

The Geology of Colorado. Arthur Lakes. A paper read before the Gold Convention, at Denver. The relation of geology to the ore deposits, and descriptions of formations in which the ores are found. 3500 w. Col Eng—Sept., 1897. No. 15347 C.

Cyanid Process.

Notes on Sump Solutions, Extractor-Box Work and Cleaning Up in the Cyanid Process. Alfred James. Abstract of a paper to be presented at the October meeting of the Institution of Mining and Metallurgy. Gives results of experiments made, concluding that increased extractions may be obtained by the proper treatment of sump solutions, or by the making up of fresh solutions. 2000 w. Eng & Min Jour—Sept. 11, 1897. No. 15268.

The Cyanid Process. Discussion of the papers of S. B. Christy, H. Van F. Furman, and George A. Packard. 9700 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15393 D.

Dredging.

River Dredging for Gold. R. H. Postlethwaite. A résumé of dredging as carried out in the river Molyneaux, in New Zealand. 1500 w. Min & Sci Pr—Sept. 4, 1897. No. 15281.

Gold.

Alchemy Redivivus. Alexander E. Outerbridge, Jr. An account of the various efforts to obtain gold, and of investigations showing how widely this metal is diffused. 1200 w. Pop Sci M—Sept., 1897. No. 14994 D.

Gold: Its Origin and Law. Robert A. Moon. From the Melbourne *Argus*. Showing reasons for believing that gold may possess something of a fixed or natural mode of occurrence in stratified country. 1300 w. Aust Min Stand—Aug. 19, 1897. Serial. 1st part. No. 15599 B.

Gold. Showing that its physical characteristics differ from every other metal. 1000 w. Bos Jour of Com—Aug. 28, 1897. No. 14968.

Gold: Its Occurrence and Extraction. Joseph Campbell. Lecture delivered before the Melbourne Chamber of Commerce. Part first explains the nature of gold, the chemistry, the occurrence, &c. 4000 w. Aust Min Stand—July 15, 1897. Serial. 1st part. No. 15066 B.

Sending Gold to Market. "Crucible." Advises the melting of small parcels of gold before transporting, and explains how easily it may be accomplished by the use of plumbago crucibles. 1500 w. Aust Min Stand—Aug. 26, 1897. No. 15600 B.

Gold Excitement.

The World's Greatest Gold Excitement. Describes the scenes on the discovery of the Ballarat and Bendigo gold fields of Australia. 1800 w. Min Ind & Rev—Sept. 2, 1897. No. 15068.

Gold Fields.

Canada's Newest Gold Field. J. T. McDonald. An account of the discovery of auriferous quartz veins on the north shore of Lake Superior, in the vicinity of the Michipicoten River, with summary of the provisions of the mining act concerning manner in which mining claims may be acquired. 900 w. Eng & Min Jour—Sept. 25, 1897. No. 15582.

The Maldon Goldfield. R. A. Moon. Extracts from a special report issued by the Victorian Secretary for Mines. Describes what is claimed to be one of the most flourishing mining centers in Victoria. 3500 w. Aust Min Stand—July 22, 1897. No. 14987 B.

The Segovia Gold Region of Nicaragua. H. H. Miller. Description based on a very hasty visit to the region, calling attention to some of the interesting features. Ill. 2000 w. Eng & Min Jour—Sept. 18, 1897. No. 15433.

Gold Hunting.

Exploring and Exploiting a Gold Country. Albert Williams, Jr., Reflections and counsel suggested by the Klondike craze. 2800 w. Eng Mag—Oct., 1897. No. 15635 B.

Gold-Ores.

The Potsdam Gold-Ores of the Black Hills of South Dakota. Frank Clemes Smith. An explanation of the classification used by the author, with description of the region, deposits, ores, &c. Map. 8800 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15403 D.

Gold Production.

The World's Gold Production. From the *New York Journal of Commerce*. Calls attention to the discoveries and improved processes of extraction which have given a new impulse to the production, and estimates the probable amount still to be extracted in certain fields. 1000 w. Sci Am Sup—Oct. 2, 1897. No. 15640.

Idaho.

An Idaho Klondike. Robert Bell. Presenting the great promise of this region and giving information of various districts. 3000 w. W Min Wld—Sept. 4, 1897. No. 15024.

Klondike.

Gold fields of Alaska and the Yukon. Cyrus C. Adams. Discusses matters of interest in relation to this region. The routes, desolation, types of mining, and important facts. 2800 w. Chau—Oct., 1897. No. 15605 C.

Life in the Klondike Gold Fields. Personal observations of Joe Ladue, the founder of Dawson, recorded by J. Lincoln Steffens. Ill. 3500 w. McClure's Mag—Sept., 1897. No. 14998.

News from the Klondike. Tappan Adney. The first of a series of letters with illustrations. Part first describes the fitting out at Victoria for the gold fields. 4000 w. Harper's Wk—Sept. 11, 1897. Serial. 1st part. No. 15025.

The Canadian Yukon Gold Fields. Review of the projected schemes for regulating the mining operations, improvement of the means of transport, &c., with other information of interest. Ill. 2500 w. Can Eng—Sept., 1897. No. 15328.

The Klondike Country. Editorial on the richness, character and resources of the country, and the rapid development sure to follow the mining excitement. 900 w. Min Ind & Rev—Sept. 16, 1897. No. 15511.

The Klondike Excitement Here and in London. Remarks on the causes affecting the enthusiasm, on the difficulties of the climate and facilities for transportation, &c. 700 w. Bradstreet's—Sept. 18, 1897. No. 15413.

The Klondike Goldfields. Harry de Windt. Comments on the dangers and difficulties of the region, gives a brief outline of the journey, information of the deposits and manner of working, scarcity of food, etc. 2500 w. Contemporary Rev—Sept., 1897. No. 15379 D.

The Klondike Gold Field. H. K. Carroll. Brief description of the country and account of the wonderful deposits, with outline of the two routes traveled. Ill. 2000 w. Sci Am Sup—Sept. 11, 1897. No. 15237.

The Yukon District. George M. Dawson. Some account of explorations made in this district, with information of the country and its resources. 1800 w. Can Min Rev—Aug., 1897. No. 15035 B.

The Yukon Mining Laws. Rossiter W. Raymond. Comments on and objections to the regulations governing placer-mining along the Yukon river and its tributaries, recently adopted by the Dominion Government. 2000 w. Can Min Rev—Aug., 1897. No. 15034 B.

Madagascar.

Gold in Madagascar. (L'Or à Madagascar.) Historical and geological account of the Madagascar gold fields, and method of working. Two articles. 7500 w. Le Génie Civil—May 1, 8, 1897. No. 15133 G.

New Mexico.

The Mineral Belt of the Mogollon Range. Carl Anderson. Describes the geology of the range and the peculiarities of the deposits. 2000 w. Eng & Min Jour—Sept. 4, 1897. No. 15208.

Oregon.

Eastern Oregon Gold Fields. E. G. Bailey. A statement of the condition of mining in this region. Ill. 1500 w. Min & Sci Pr—Aug. 28, 1897. No. 15007.

Peru.

Mining in the Department of Ancachs, Peru. F. J. Schafer. Brief reports of the different companies, giving mining conditions and general remarks on Ancachs. 2000 w. Eng & Min Jour—Sept. 4, 1897. No. 15207.

Precious Metals.

See same title under Economics and Industry, Currency and Finance.

Prospecting.

Notes on Prospecting. Jno. W. Gray. Directions for prospecting, with suggestions, appliances needed, things to be observed, &c. 3500 w. Min & Sci Pr—Sept. 11, 1897. No. 15364.

Slimes.

The Solution of Gold in Accumulated and Other Slimes. W. A. Caldecott. Read before the Chemical and Metallurgical Society of South Africa. Reviews the operations involved in dissolving the gold in slimes containing reducing substances, with some details of laboratory practice. 2300 w. Min & Sci Pr—Sept. 18, 1897. No. 15521.

Tasmania.

The Tasmania Mine. Illustrated description of the plant, and the work of the Lührig vanners. 1500 w. Aust Min Stand—July 29, 1897. No. 15067 B.

Veins.

Vein Intersections in Clear Creek County, Colo. James Underhill. Illustrated examples showing some of the causes that operate to make enrichments at intersections. 900 w. Eng & Min Jour—Sept. 18, 1897. No. 15435.

IRON AND STEEL.

Armor-Plates.

Tests of Armor-Plates. Report of tests giving information of considerable value in regard to surface cracks, laps, &c. 1000 w. Engng—Sept. 3, 1897. No. 15338 A.

The Carpenter Process for Making Armor Plate. A letter from J. H. Carpenter explaining the nature of the process, with editorial com-

ment questioning the merits, and the correctness of the estimate of cost. 1400 w. Eng News—Sept. 16, 1897. No. 15377.

Comparative Armor Tests in Austria. (Essais Comparatifs en Autriche sur le Plaques de Blindage.) Discussing the results of test of armor plate of the various European makers with especial reference to hardened and non-hardened surfaces. 4500 w. Le Génie Civil—June 12, 1897. No. 15150 D.

Blooming Mill.

The American Blooming Mill. Ralph Crooker, Jr. Read before the Engineers' Soc. of W. Penna. Reviewing the conditions existing previous to the building of blooming mills, and gives the history of development in this industry in America. 6000 w. Ir Trd Rev—Sept. 23, 1897. No. 15522.

Charcoal Iron.

Southern Charcoal Iron. S. L. Graham. Discusses its manufacture for car wheel purposes from an economic standpoint. 3000 w. Tradesman—Sept. 15, 1897. No. 15419.

Cleaning Iron.

See same title under Civil Engineering, Bridges.

Gogebic Range.

Some Dike Features of the Gogebic Iron-Range. C. M. Boss. A short description of the characteristics and peculiarities of the principal dikes which have been exposed in this range. 3300 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15394 D.

Hardening.

The Microstructure of Steel and the Current Theories of Hardening. Continued discussion of the paper of Mr A. Sauveur presented at the Colorado meeting, Sept., 1896. 14000 w. Trans Am Inst Min Engs—Sept., 1897. No. 15392 D.

Iron and Steel Industry.

The British Iron and Steel Industry during the Queen's Reign. Part first deals with the position of this industry in the early period of the reign. 1100 w. Ir & St Trds Jour—Sept. 18, 1897. No. 15540 A.

Iron Mining.

Methods of Iron Mining in Northern Minnesota. F. W. Denton. An illustrated description of the methods of mining employed. 9000 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15404 D.

Iron Ore.

The Iron Ore Supply. John Birkinbine. Presented at the Lake Superior meeting of the Am. Inst. of Min. Engs. Shows the importance of the Lake Superior region as a contributor to the iron ore supply, its development and present status, and advances made elsewhere. 2800 w. Ir Age—Sept. 2, 1897. No. 15062.

Iron Preservations.

See same title under Architecture and Building, Miscellany.

Preserving Iron from Corrosion. Max Soltz. Conclusions from a paper read before the St. Paul Engineers' Assn. Describes a system which it is believed will protect iron and steel for a longer period than any other system now in use. 1000 w. Bos Jour of Com—Aug. 28, 1897. No. 14967.

Protective Coverings for Iron. Charles E. Koons. The necessity of smoothing rough surfaces before painting, and the right preparation and proper application are discussed. 1300 w. R R Car Jour—Sept., 1897. No. 15225.

Low-Carbon Steel.

The Connection between the Hardening Power and the Retardations of Low-Carbon Steel. Henry M. Howe. A comparison of the writer's results with those obtained by J. O. Arnold, and a reply to his remarks on work of the author. 1800 w. Eng & Min Jour—Sept. 25, 1897. No. 15581.

Open-Hearth.

Open-Hearth Steel and Its Manufacture by the Illinois Steel Company. T. L. Condron. Historical sketch with description of process and the work as carried on by this company. Ill. 4800 w. R R Gaz—Sept. 3, 1897. No. 15032.

The Bertrand-Thiel Modification of the Open-Hearth Process. J. S Robeson. A general description of the method, with some detailed facts in connection with it. Ill. 2200 w. Pro Engs' Club of Phila—July, Sept, 1897. No. 15251 D.

Ores.

The Development of Lake Superior Iron-Ores. D. H. Bacon. A short résumé of what has been done in this industry. 1400 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15398 D.

Prices.

The Iron and Steel Boom of 1879 and 1880. A complete history of the celebrated boom from the annual report of James M. Swank, Secretary of the Iron and Steel Assn., dated May 20, 1880. 1500 w. Bul of Am Ir & St Assn—Sept. 10, 1897. No. 15321.

Steel Works.

The Sandvik Steel Works. Particulars of plant and operation. Ill. 1800 w. Ir & Coal Trds Rev—Aug. 27, 1897. No. 15204 A.

Testing.

The Influence of the Testing Method Upon the Result of Bending Tests at Low Temperatures. From *Stahl und Eisen*. Results of bending tests by M. Rudeloff, director of the Imperial German Testing Station. 700 w. Am Mfr & Ir Wld—Sept. 24, 1897. No. 15568.

Tires.

See same title under Mechanical Engineering, Miscellany.

Wrought Iron.

See same title under Electrical Engineering Miscellany.

MINING.

Accidents.

Accidents in American Metal Mines. Editorial comment on recently published statistics of the metal mines of Colorado, making comparison with the statistics for the United Kingdom. 1800 w. Eng & Min Jour—Sept. 4, 1897. No. 15206.

Brake.

Experiments with a New Checking Brake. (Versuche mit einer Neuen Bremsend Wirkenden Fangvorrichtung.) Giving the data of tests of a safety check for mine hoists. Teeth on eccentric sheaves engage with shaft timbers. 1600 w. 1 plate. Glückauf—September 4, 1897. No. 15190 D.

Explosives.

Explosives in 1896. Editorial review of the Annual Report of Her Majesty's Inspector of Explosives, noting the comparative safety in the factories, the character of the accidents, &c. 1600 w. Engng—Sept. 17, 1897. No. 15557 A.

Japanese Mines.

Some Japanese Mines. W. L. Austin. An interesting description of the primitive methods employed, some remarkable results in mining and treating low grade silver, gold and copper ores and other matters of interest. Ill. 3300 w. Col Eng—Sept., 1897. Serial. 1st part. No. 15346 C.

Mine-Dam.

A Mine-Dam. William Kelly. Describes a dam constructed in the Curry mine, at Norway, Mich., on the Menominee range, and the results. Ill. 1100 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15395 D.

Mine Regulations.

Mine Regulations in Siberia. Regulations relating to fresh air, ventilation, shafts, &c. 1100 w. Am Mfr & Ir Wld—Sept. 17, 1897. No. 15420.

Mining Machines.

Increasing Use of Coal Mining Machines. Official figures, prepared by E. W. Parker, of the United States Geological Society, showing how machinery is superseding the pick. 1500 w. Am Mfr & Ir Wld—Sept. 3, 1897. No. 15231.

See same title under Economics and Industry, Labor.

Prussia.

Advances in Mining in Prussia in 1896. (Versuche und Verbesserungen beim Bergwerksbetriebe in Preussen während des Jahres 1896.) A very full review of improvements in tools, methods and appliances. Three articles. 1200 w. Glückauf—Aug. 21, 28, Sept. 4, 1897. No. 15187 G.

Roads

New Methods of Cutting Roads in Mines. Jules Collin. Translated from *Revue Universelle des Mines*. An endeavor to discover the most rapid way of accomplishing the work when blasting is not possible. Ill. 1200 w. Col Cuard—Sept. 17, 1897. No. 15565 A.

Shaft Sinking.

A New Freezing Process for Sinking Shafts. Brief description of a process invented by Louis Koch. Gaseous carbonic acid, ammonia, or a mixture of dioxide of sulphur, is circulated in specially constructed tubes whereby a degree of cold of from 40 to 60 degrees Cent. is generated and communicated to the ground. Ill. 700 w. Col Guard—Sept. 17, 1897. No. 15564 A.

Shaft Sinking near Wigan. C. M. Percy. Describes a very difficult piece of mining work. The sinking of pit-shafts through almost inexhaustible water feeders, extending to a substantial depth. 1300 w. Col Guard—Sept. 10, 1897. No. 15458 A.

MISCELLANY.

Aluminum.

Aluminum: A New Comer Among the Metals. The history of the early difficulties with this metal, the success and uses. 3800 w Am Rev of Revs—Oct., 1897. No. 15643 C.

Notes on Aluminum: The Relationship of its Cost of Production to its Use as a Conductor. John B. C. Kershaw. The use of aluminum as a conductor, in place of copper, in electrical construction work, and its bearing on the future development of the aluminum industry. 1200 w. Elect'n—Aug. 27, 1897. No. 15211 A.

The Aluminum Industry. A summary of the latest facts and figures available, relating to the production and cost of aluminum. 1000 w. Engng—Sept. 17, 1897. No. 15558 A.

Brass.

The Influence of Lead on Rolled and Drawn Brass. An account of the discovery that lead gives desirable cutting qualities to brass, with experimental study of its action. Ill. 7700 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15402 D.

China.

The Mineral Resources of China. From the London *Mining Journal*. Information of the mineral deposits, of which coal is the more plentiful. 1700 w. Eng & Min Jour—Sept. 11, 1897. No. 15267.

Clays.

The Clays and Clay-Working Industry of Colorado. Heinrich Ries. Information of the clay bearing formations, in the belief that knowledge of the available materials will lead to an expansion of the clay-working industry of the state. 1800 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15400 D.

Diamonds.

Diamonds in Steel. (Les Diamants dans l'Acier.) An account of the discovery of microscopic diamonds in steel, by Prof. Rossel, of Berne. 1600 w. Le Génie Civil—May 15. 1897. No. 15142 D.

Dynamite.

Conditions for the Installation of Underground Dynamite Magazines. From a report by the French Explosives Commission published in the *Annales des Mines*. Gives the principle of the arrangements originally proposed by the Commission, with experiments made and conclusions. 4500 w. Col Guard—Aug. 27, 1897. No. 15081 A.

Fullers' Earth.

The Fullers' Earth of South Dakota. An account of the deposits of Fuller's earth, which, next to Florida, are the most extensive thus far discovered in the United States. 800 w. Trans Am Inst of Min Engs—Sept., 1897. No. 15401 D.

Hand-Jig.

An Experimental Hand-Jig. Paul Buttgenbach. Describes an apparatus used for making preliminary tests previous to treating a large quantity of ore with machinery, and also for tests of samples. Ill. 800 w. Eng & Min Jour—Sept. 11, 1897. No. 15266.

La Plata.

The La Plata Mountains. Arthur Lakes. Where they are, what they look like, and their possibilities as a mining region. A description of the beginning of a laccolith, its progressive development into a mountain, and the influence of this kind of geological formation on the deposition of ores. Ill. 3500 w. Col Eng—Sept., 1897. Serial. 1st part. No. 15351 C.

Metallurgy.

The Metallurgical Industries of Canada. Abstract of a discourse by Prof. Roberts-Austen, at the meeting of the British Assn. in Toronto. The importance of the metals of the country, with much general information. 2700 w. Col Guard—Aug. 27, 1897. No. 15082 A.

Mine Waters.

Ferric Sulphate in Mine Waters and Its Action on Metals. L. J. W. Jones. Paper read before the Colorado Scientific Society. Gives experience at Idaho Springs, with experiments, analyses, &c. Also discussion. 2800 w. W Min Wld—Sept. 11, 1897. No. 15302.

Newfoundland.

The Undeveloped Mineral Wealth of Newfoundland. A. E. Outerbridge, Jr. Brief historical review of the discovery and information of the great variety of minerals. Ill. 3500 w. Jour Fr Inst—Sept., 1897. No. 15051 D.

Ovens.

The Principal Methods of Distillation of Wood. (Des Principal Methods de Distillation Du Bois.) A monograph, describing the various kinds of ovens used in Europe, with data of products and accounts of methods of operation. 7000 w. La Revue Technique—Aug. 25, 1897. No. 15123 D.

Petroleum.

The Production of Petroleum. Particulars derived from official and other sources, showing the state of the industry in some of the principal petroleum-producing countries. 2800 w. Bd of Trd Jour—Sept., 1897. No. 15542 A.

Production.

Production of Lead and Zinc in 1896. Charles Kirchhoff. From the Annual Report of the U. S. Geological Survey. Tabulated statements of the total gross production since 1873, with comment. 900 w. Am Mfg & Ir Wld—Sept. 24, 1897. No. 15569.

Rare Metals.

The Rare Metals. Some metals worth more than gold, on account of their scarcity. 700 w. Min Ind & Rev—Sept. 9, 1897. No. 15353.

Southern United States.

The Mining and Metallurgical Industries of the Southern States. Part first relates to the mining of iron ores, and gives illustrations of the mines in Alabama, with details of the economic conditions. 2000 w. Ir & Coal Trds Review—Sept. 3, 1897. No. 15308 A.

Titanium.

Titanium and its Compounds. (Le Titane et ses Composés.) A discussion of the treatment of titaniferous ores in the blast furnace, by M. Auguste Rossi. Three articles. 10000 w. Le Génie Civil—June 26, July 3, 10, 1897. No. 15156 H.

MUNICIPAL ENGINEERING.

GAS SUPPLY.

Acetylene.

Solutions of Acetylene and Their Explosive Properties. Messrs. Berthelot and Vieille. Read before the Academie des Sciences, Paris. A study of the properties of acetylene solutions. 2500 w. Pro Age—Sept. 1, 1897. No. 14999.

Ammonia.

The Agricultural Value of Sulphate of Ammonia. Extracts from the discussion of F. J. R. Carulla's paper. 4000 w. Jour Gas Lgt—Sept. 14, 1897. No. 15520 A.

Burner.

Development of an Atmospheric Burner. A. Bandsept. A pamphlet upon an auto-mixing "atomizing" burner for combustion of high intensity. Statement of the principles with illustrated description of burners and their action. 5000 w. Pro Age—Sept. 15, 1897. No. 15366.

The Bandsept Incandescent Burner. A. Bandsept. Abstract of a paper read before the Belgian Assn. of Gas Fitters. Description with experiments and results. 1400 w. Pro Age—Sept. 1, 1897. No. 15000.

Bye-Products.

Dr. Bunte on Bye-Products and Auxiliary Materials. Translation from the *Journal für Gasbeleuchtung*, slightly abbreviated, of a paper presented at the meeting of the German Assn. 1700 w. Jour Gas Lgt—Aug. 31, 1897. No. 15255 A.

Coal Gas.

Notes on the Enrichment of Coal Gas. The first of a series of articles making a study of methods of enrichment. 3200 w. Jour Gas Lgt—Sept. 7, 1897. No. 15358 A.

The Early Days of Gas. Articles from the *Dundee Advertiser*. The history of the discovery of coal gas and its earliest use as an illuminant. 1500 w. Gas Wld—Aug. 28, 1897. No. 15091 A.

Convention.

The Technical Society of Gas Manufacture in France. (Société Technique de l'Industrie du Gaz en France.) A report of the Convention of the French Gas Light Association recently held in Paris discussing many questions of current interest. Two articles, 4000 w. Le Génie Civil—June 26, July 10, 1897. No. 15157 G.

Denver, Colo.

Mayor McMurray's Veto of the Opposition Charter for Denver, Colo. Text of the veto under which the mayor disapproves the action of the Denver City Council, in granting a franchise to the projectors of an opposition gas works. 4000 w. Am Gas Lgt Jour—Sept. 20, 1897. No. 15436.

Fuel Gas.

Gas as Fuel. F. Foveaux. Read before the Pacific Coast Gas Assn. A report of investigations made to improve the methods by which gas is burned in ordinary stoves. Followed by discussion. Ill. 2200 w. Am Gas Lgt Jour—Aug. 30, 1897. No. 14976.

Furnace.

The Rouen Furnace for Carbonic Oxide. (Four à Oxyde de Carbone dit "Four de Rouen.") An illustrated description of the improved regenerative gas furnace for heating gas retorts by producer gas. 2500 w. Le Génie Civil—May 8, 1897. No. 15137 D.

Gas Producer.

The Kitson Gas Producer. John E. Fry. Enumerates the evils which the operator of the ordinary gas producer encounters, explains the principles involved, and describes the mechanism of the Kitson producer, and its operation. 6000 w. Ir Age—Sept. 30, 1897. No. 15627.

Gas Undertaking.

A Descriptive Sketch of the Elland-Cum-Greetland Gas Undertaking. Address of Robert Porter to the Manchester District Institution of Gas Engineers. Also description of the coal elevating and conveying machinery used. Ill. 4000 w. Jour Gas Lgt—Aug. 31, 1897. No. 15254 A.

Great Yarmouth.

Electricity and Gas in Great Yarmouth. W. J. Carpenter. Read before the Eastern Counties Gas Managers' Assn. Describes the electricity works, reports progress in both electricity and gas. Discussion. 4000 w. Gas Wld—Sept. 11, 1897. No. 15425 A.

Hydraulic Mains.

A Difference in Hydraulic Mains. P. Egan. Read at North of Ireland Assn. of Gas Managers, and followed by discussion. Treats of pitched mains and choked ascension-pipes. 2000 w. Jour Gas Lgt—Aug. 24, 1897. No. 15012 A.

Indiana Gas.

Gas in Indiana. From the Indianapolis *Journal*. On the situation in Indiana gas affairs, and the changes that have taken place during the past ten years. 1500 w. Pro Age—Sept. 15, 1897. No. 15367.

Naphthalene.

Young and Glover's Naphthalene Remedy. Reproduction of the patent specification. 2500 w. Gas Wld—Sept. 11, 1897. No. 15427 A.

Natural Gas.

Natural Gas Production in the United States. From advanced sheets of the Eighteenth Annual Report of the United States Geological Survey. Report of the production for 1896, with the condition of the fields, value of the gas, consumption and distribution. 2000 w. Am Mfr & Ir Wld—Sept. 17, 1897. No. 15421.

Philadelphia Gas.

Private Control of Gas in Philadelphia. A statement of the condition of affairs. Poor gas, poor works, poor management under municipal control, and the offers of private companies to make all necessary improvement at great cost, yet sell the gas cheaper than under the present management. 4400 w. Pro Age—Sept. 15, 1897. No. 15369.

Purifying Houses.

Noxious Air in Purifying Houses. Comments on some recent researches by Herr H. Drehschmidt, the chemist of the Berlin Municipal Gas-Works, with some of the technical results arrived at in the investigations. 3000 w. Jour Gas Lgt—Aug. 31, 1897. No. 15253 A.

Regenerative Settings.

Experiences with Regenerative Settings. Frank Prentice. Read before the Eastern Counties Gas Managers' Assn. A record of troubles and partial failures. Followed by discussion. 4200 w. Jour Gas Lgt—Sept. 14, 1897. No. 15519 A.

Solutions.

Solutions of Solids in Gases. M. P. Villard. Summary of a communication to the French Physical Society. Experiments showing that gases possess the property of dissolving liquids or solids under ordinary circumstances. 2000 w. Gas Wld—Sept. 4, 1897. No. 15322 A.

Street Lighting.

Street Lighting by Incandescent Gas Burners. C. R. Bellamy, superintendent of the Liverpool Corporation, reports concerning the Incandescent gas burner (Welsbach patent). States advantages, difficulties encountered and overcome, with results, and describes the lamp. Ill. 1600 w. Gas Wld—Sept. 11, 1897. No. 15426 A.

SEWERAGE.

Flow.

The Methods and the Results of Experiments for the Determination of the Velocity of the Flow of Water, under Direction of the Bureau of Surveys, City of Philadelphia. Charles Jacobsen. Describes experiments illustrating the work being done under the direction of the Bureau of Surveys, to determine the size of sewers, the velocity of the flow of water, and the relative percentage of the amount of rainfall which would reach the sewer. Discussion follows. Ill. 6000 w. Pro Engs' Club of Phila—July-Sept., 1897. No. 15248 D.

Regulatory Acts.

Regulatory Acts by City Councils. The Indianapolis and other cases. Reviews recent attacks by municipalities on gas corporations, with editorial comment. 7000 w. Pro Age—Sept. 15, 1897. No. 15365.

Sewers.

Heavy Sewer Work. Describes the construction of brick sewers in the twenty-third and twenty-fourth wards of New York city. 1100 w. Eng Rec—Aug. 28, 1897. No. 14980.

Operation of the Los Angeles Outfall Sewer and Sewage Irrigation. Burr Bassell. A brief description of the sewer with account of its operation, and of the sewage irrigation and its results. Discussion follows. Ill. 7800 w. Jour Assn of Engng Soc—Aug., 1897. No. 15301 C.

Separate Sewage Systems. (Ueber Trennungssysteme.) A discussion by Chief Engineer Metzger, of Bromberg, of the status of the separate system in Germany, with sections of double-channel sewers. 7500 w. Gesundheits Ingenieur—August 15, 1897. No. 15172 B.

Sewer Outlets in Springfield, Mass. Brief illustrated description of the construction of three sewer outlets in the Connecticut river. 500 w. Eng Rec—Sept. 11, 1897. No. 15330.

The Round Hill Street-Sewer Tunnel in Waterbury, Conn. Detailed description of the construction of a sewer tunnel, necessarily built very deep. Ill. 1500 w. Eng Rec—Aug. 28, 1897. No. 14979.

Sewage.

Recent Developments in Sewage Purification. Gilbert Thomson. An address at the opening of the Sanitary Association of Scotland. Discusses the three chief methods in use at the present time—on land, by precipitation, and by bacteriological methods. 1600 w. Arch, Lond—Sept. 3, 1897. No. 15310 A.

The Biological Purification of Sewage. W. J. Dibdin. Gives the history of the process, the work of the Barking filter, the Sutton filter, the septic tank system, and discusses the future developments. 1800 w. Prac Eng—Sept. 10, 1807. No. 15424 A.

The Sewage-Disposal Plant at Altoona, Pa. Harvey Linton. Describes the location and conditions at Altoona, with the work in preparing for filtration. Tabulated statements of all pids received are given, with a general map and profile view of the sewer, and the eastern sewage carrier, in the filter bed, &c. 5500 w. Pro Engs' Club of Phila—July-Sept., 1897. No. 15247 D.

The Sewage Problem. Editorial discussion of how to deal with sewage in England. The self-purifying process in operation in Sutton (Surrey) District Council is favorably reported. 1800 w. Prac Eng—Sept. 10, 1897. No. 15423 A.

Treatment of the Effluent from Sewage Precipitation Works. Kenneth Allen. Presents the frequent necessity of subsequent purification, giving the methods used in numerous foreign cities, and data furnished by recent investigators. 3400 w. Munic Engng—Sept., 1897. No. 15021 C.

Sewage Farm.

A Visit to a New Sewage Farm at Berlin. Allen Hazen. Photographs taken during the visit are given and described. All the sewage is treated by applying it to land. 1500 w. Eng News—Sept. 16, 1897. No. 15375.

Sewage Lift.

Adam's Patent Sewage Lift. Illustrated description of invention to meet the difficulty of lower levels. 900 w. Ind Engng—Aug. 21, 1897. No 15494 D.

STREETS AND PAVEMENTS.

Asphalt Paving.

A New Development in Machinery for Asphalt Paving. Illustrated description of a portable plant for practical work, invented by Frederick A. Hetherington, of Indianapolis, Ind. 1400 w. Sci Am—Oct. 2, 1897. No. 15620.

Asphalt and Asphalt Pavements. George W. Tillson. Slightly abbreviated from a paper read before the Am. Soc. of Civ. Engs., May 5, 1897. Discusses asphalt in the forms used for pavements, and the various questions related to its use. 8500 w. Eng News—Sept. 2, 1897. No. 15019.

Municipal Maintenance of Asphalt Pavements. Edward P. North. Gives the specifications for maintenance in New York City, and discusses the difficulties. 1100 w. Eng Rec—Sept. 4, 1897. No. 15041.

Utah and Kentucky Asphalt Pavements. Information condensed from a number of sources. 1800 w. Eng Rec—Sept. 4, 1898. No. 15040.

Omaha.

The New Paving Specifications of Omaha. Copy of the forms for submitting bids and the classification of work, as prepared by the city engineer. 3500 w. Munic Engng—Sept., 1897. No. 15023 C.

St. Louis.

Streets of St. Louis. Information of the paving used in the improved streets, with the specifications for the brick paving. Ill. 1000 w. Brick—Sept., 1897. No. 15020.

Street Cleaning.

The Cleaning of a Great City. George E. Waring, Jr. Describes the former condition of New York streets, and their improved present condition. The reorganization of the department, disposing of refuse, &c. 6000 w. McClure's Mag—Sept., 1897. No. 14997.

WATER SUPPLY.

Croton Aqueduct.

The Croton Aqueduct Embankment. H. K. Landis. Improvements made necessary the piercing of the Old Croton Aqueduct, and a view of the embankment is given, with historical review of the work. 1100 w. Eng News—Sept. 9, 1897. No. 15270.

Hydraulics.

An Interesting Hydraulic Experiment. Marvin E. Sullivan. Gives experiment demonstrating that the flow in small pipes follows the same law in all dimensions. 1000 w. Min Ind & Rev—Sept. 16, 1897. No. 15512.

Hydrostatic Pressure.

The Internal Hydrostatic Pressure in Masonry, with Especial Reference to Masonry Dams. Arnold Emil Broenniman and Harry Hurson Ross. Gives a series of experiments, describing apparatus used and method of testing, showing that water pressure is transmitted through ordinary stones, and through dams and how it may affect the stability, and gives some of the possible means of reducing or eliminating the effect. Ill. 13000 w. Jour of Soc of W Engs—Aug., 1897. No. 15611 D.

Pressures.

Pressures Resulting from Changes of Velocity of Water in Pipes. J. P. Frizell. A record of experiments and results. 2300 w. Pro Am Soc of Civ Engs—Aug., 1897. No. 14996 F.

Pumping Plant.

Test of High Duty Pumping Plant. Dabney H. Moury, Jr. Describes the test of the plant of the Peoria Water Co., with brief description of changes made and the results obtained. Ill. 2500 w. Fire and Water—Sept. 4, 1897. No. 15044.

Reservoirs.

New Reservoirs of the Minneapolis Water-Works. Illustrated description of the work in progress for the improvement and increase of the water supply of the city. 2400 w. Eng Rec—Sept. 11, 1897. No. 15329.

Simla.

The Simla Water-Supply. Information from the Annual Report of the Simla Municipality regarding the working of the water-supply system, and the proposed extension of the works. 2400 w. Ind Engng—Aug 21, 1897. No. 15495 D.

Stream Flow.

Observations on Rain Fall and Stream-Flow in Eastern Pennsylvania. John E. Codman. Discusses the quantity of water available from a given watershed, either as a source of water supply or water power. 4200 w. Pro Engs' Club of Phila—July-Sept., 1897. No. 15252 D.

Water-Pipe.

Recovering a Line of 24 and 30-in. Cast-Iron Water-Pipe at Boston. Frederic I. Winslow. Changes in street grades made necessary the relaying of some large water mains, and it was decided to raise the old pipes for future use. The method employed is described. Also a similar piece of work elsewhere. 1200 w. Eng News—Sept. 9, 1897. No. 15271.

Water-Rates.

Comparison of Water Rates and Rules. Information collected by Dabney H. Maury, Jr., superintendent of the Peoria Water Co., regarding the rules, rates, and general practice in American cities. 3000 w. Munic Engng—Sept., 1897. No. 15022 C.

Water-Works.

City of Birmingham Corporation Water-Works. Henry Davey. Part first gives an historical account of the water supply since 1826, the present supply, and the interim resources. 1500 w. Mech Wld—Aug. 27, 1897. Serial. 1st part. No. 15076 A.

I. Notes and Distribution. J. Shaw. II. Electrical Water-Level Recorders. W. Coles Finch. Abstracts of two papers read before the British Assn. of Water Works Engs., with discussion. The first paper describes an ideal service reservoir, and discusses the factors which have to be considered in laying out the distributing mains. The second describes the construction and use of instrument named. 4300 w. Jour Gas Lgt—Aug. 24, 1897. No. 15013 A.

MISCELLANY.

Address.

Presidential Address before the Congress of the Sanitary Institute at Leeds, Eng. Dr. Robert Farquharson. He discusses the progress of hygiene, defects of civilization, increase of new diseases, value of light, housing and health questions. 4400 w. Arch, Lond—Sept. 17, 1897. No. 15567 A.

Baths.

Birmingham (Eng.) Baths. Information from a book prepared by J. Cox, superintendent and engineer of the baths department, giving a history of the public baths, their cost, maintenance, &c. 2000 w. Arch, Lond—Sept. 10, 1897. No. 15446 A.

Conveniences.

See same title under Architecture and Building, Plumbing and Gas Fitting.

Dust Cart.

A Steam Dust Cart. Description, with illustration, of a composite vehicle in use in Chiswick. 1500 w. Engng—Sept. 17, 1897. No. 15552 A.

Garbage.

Treatment of Household Garbage in Philadelphia and New York. (Traitmente des Ordures ménagères á Philadelphie et à New York.) Discussing the feasibility of introducing an incinerating plant in Paris, similar to those used in the American cities. 4500 w. Le Génie Civil—June 5, 1897. No. 15148 D.

Municipal Restaurant.

The Municipal or Co-operative Restaurant of Grenoble, France. C. Osborne Ward. An account of a restaurant owned and indirectly managed by a city with unquestioned success for a period of forty-five years. 3500 w. Bul of Dept of Labor—Sept., 1897. No. 15406 D.

Piers.

Recreation Piers. Edward C. O'Brien. Describing the opening of one such pier, and plans concerning others. 2200 w. Munic Aff—Sept. 1897. No. 15946.

Twentieth Century City.

The Problem of the Twentieth Century City. Josiah Strong. Discusses the growing increase of population in cities and the changed conditions causing this concentration. 2200 w. N Amer Rev—Sept., 1897. No. 14989 D.

Reform.

The progress of Municipal Reform. Clinton Rogers Woodruff. Address delivered at the Louisville Conference for Good City Government. Reviews the principal achievements of the more active organizations and draws conclusions. Considers the outlook promising. 6000 w. Munic Aff—June, 1897. No. 15952 C.

Refuse.

The Willoughby Refuse Destructor. Illustrated description of a destructor that has been working with satisfaction at Lewisham, Eng. It consists essentially of a furnace and a revolving cell. 800 w. Eng, Lond—Sept. 17, 1897. No. 15547 A.

RAILROAD AFFAIRS.

NEW CONSTRUCTION.

Africa.

The Railways of Equatorial Africa. Particulars about railway building in the Soudan, and information of other railways existing and projected. 3800 w. Trans—Sept. 17, 1897. No. 15575 A.

Electric Railway.

The Auxiliary Electric Railway at Meckenbeuren–Tettnang. (Die Elektrische Nebeneisenbahn Meckenbeuren–Tettnang.) Illustrated description of a special "feeder" line operated in connection with steam road. Part 1. 4000 w. Zeitschr d Ver Deutscher Ing—Sept. 4, 1897. No. 15112 D.

Extension.

Railway Extension in Dumbartonshire. Illustrated description of interesting construction work. 2400 w. Engng—Aug. 27, 1897. No. 15080 A.

India.

The Mushkaf Bolan Railway, Baluchistan, India. James Ramsay. Describes the Bolan Pass and the railway projects of this region. 5500 w. Ind & East Eng—Aug. 14, 1897. Serial. 1st part. No. 15282 D.

Rack Railways.

Progress in the Perfection of the Rack Railway. E. L. Corthell. Tracing the origin of rack-bar railroads, and describing in detail the project of the Jungfrau road. Ill. 4700 w. Eng Mag—Oct., 1897. No. 15636 B.

Tunnels.

The Hamilton Tunnel. Description and illustrations of design, methods of construction and plant installed. 4700 w. Eng Rec—Aug. 28, 1897. No. 14997.

The Tunnels of the First Division of the Mushkaf-Bolan Railway, India. William Arthur Johns. Describes the construction of the six short tunnels found necessary by the route traversed, with statement of cost. 3000 w. Ind & East Eng—Aug. 28, 1897. Serial. 1st part. No. 15602 D.

MAINTENANCE OF EQUIPMENT.

Axles.

Discussion on Axles. R. A. Mould. A paper read before the National Railway Master Blacksmiths' convention. Advocates steel axles. Also a statement of the superiority of iron axles, as presented in a paper by George F. Hinkens. 3500 w. Ry Rev—Sept. 11, 1897. No. 15291.

Box Cars.

New Box Cars for the Chesapeake and Ohio. Illustrated description. 1200 w. R R Gaz—Sept. 3, 1897. No. 15030.

Brake Levers.

Standard Brake Levers. Pulaski Leeds. Discusses the advantages of standards, and the unmechanical system now in use. 2200 w. R R Car Jour—Sept., 1897. No. 15219.

Brake Shoes.

A Contribution to the Theory of Brake Shoes. Letters called out by article published Aug. 27, with editorial discussion. 2500 w. R R—G az Sept. 24, 1897. No. 15526.

Caboose.

Improved Caboose for the Lake Shore and Michigan Southern Railway. Illustrated description of cars designed by A. M. Waitt, showing a greater degree of convenience by careful arrangement and some innovations in construction. 800 w. Ry Rev—Sept. 25, 1897. No. 15594.

Car Lighting.

The Lighting of Railway Cars. H. Gordes. Read before the Assn. of German Technical Engineers. Part first discusses briefly the various kinds of illumination, especially the electric light and Pintsch gas. 2700 w. Pro Age—Sept. 15, 1897. Serial. 1st part. No. 15368.

The Lighting of Trains by Acetylene. (Eclairage des Trains à l'Acétylène.) Discussing the various experiments made in Germany and France, and recommending a mixture of acetylene and nitrogen as being safe under pressure as well as efficient and economical. 5000 w. Le Génie Civil—July 3, 1897. No. 15160 D.

Cars.

Carriages for the South-Eastern Railway. Illustrations, with description of the interior work of the cars composing the new vestibule train for the Continental Express. 1500 w. Engng—Sept. 17, 1897. No. 15553 A.

Corridor Carriages for the Eastern Railway of France. Illustrated description. 1100 w. Engng—Sept. 10, 1897. No. 15460 A.

Hospital Car on the Long Island Railway. Brief illustrated description of a nicely fitted hospital car for use at a wreck. 500 w. Ry Rev—Sept. 25, 1897. No. 15596.

New South Wales Railways. Passenger Carriages. Information of the passenger vehicles added during the term of office of the present Railway Commissioners. Ill. 1700 w. Eng, Lond—Aug. 27, 1897. No. 15086 A.

New Trains on the C. B. & Q. Railroad. Illustrated description of two handsome trains of cars, said to be probably the finest built in any country, with the exception of the World's Fair train. 500 w. R R Car Jour—Sept., 1897. No. 15221.

Refrigerator Cars for the Colorado Midland Railroad. Illustrated description of cars for the handling of perishable freight. 1500 w. Ry Rev—Sept. 4, 1897. No. 15215

The English Royal Train. Brief illustrated description of the carriages recently built for the use of the Queen of England. 700 w. R R Car Jour—Sept., 1897. No. 15223.

Grates.

Locomotive Grates. Condensed report of the committee of the Am. Ry. Mas. Mach. Assn. Ill. 5500 w. Ry Rev—Sept. 4, 1897. No. 15217.

Locomotives.

An Electric Railway Locomotive. Illustrated description of a locomotive adapted to be used on ordinary railways for shunting and other miscellaneous work, recently constructed by the Allegemeine Elektricitäts-Gesellschaft, Berlin. 1300 w. Elec Rev, Lond—Sept. 17, 1897. No. 15580 A.

Brooks' Twelve-Wheelers for the Buffalo, Rochester & Pittsburg. Engraving, elevation and sections with dimensions and description. 700 w. R R Gaz—Sept. 24, 1897. No. 15527.

Compound Locomotives of the Russian State Railway. (Die Verbund-lokomotiven der Preussischen Staatseisenbahn.) Discussing a great variety of starting valves and mechanism for compound locomotives. 1 plate. 8000 w. Glaser's Annalen—August 1, 1897. No. 15-168 D.

Compound Locomotive with Four Cylinders. (Verbund-locomotive mit Vier Dampfcylindern.) An illustrated description of von Borries latest design of compound locomotive. Four cylinders with separate cranks, but combined valve gear, give excellent distribution. 2500 w. Glaser's Annalen—August 15, 1897. No. 15170 D.

Cupped Fire-Box Sheets for Locomotives—Chicago, Rock Island and Pacific Ry. An application of the method of Joseph Cour, aiming at greater flexibility of the fire-box sheet and getting the stay-bolt ends less exposed to the fire. 1100 w. Ry Mas Mech—Sept., 1897. No. 15036.

How a Model Locomotive Was Made. Illustrated description of a model of a locomotive belonging to the D 2 class of the London, Brighton and South Coast Railway. It was built by J. Bradbury Winter, at Brighton, and the undertaking has occupied nearly thirteen years. The scale is 1 in. to the foot. 3500 w. Eng, Lond—Sept. 17, 1897. No. 15546 A.

Locomotive Improvement. Editorial review of recent discussions on this subject. 1200 w. Am Eng & R R Jour—Sept., 1897. No. 14-984 C.

Passenger Tank Locomotive; Lung-Wu Railway, China. General dimensions and description of locomotives built for this line, by the Brooks Locomotive works. Ill. 700 w. Eng News—Sept. 9, 1897. No. 15275.

Sumatra Rack Railway Locomotives. D. L. Graadt van Roggen. Some information of rack railway construction with detailed description of the locomotives. Ill. 3000 w. Engng—Sept. 3, 1897. No. 15337 A.

The Heilmann Electric Locomotive. Illustrated description of this locomotive since recent improvements have been made. 1400 w. Sci-Am—Sept. 4, 1897. No 15008.

The Mathematics of the Performance Sheet. George S. Hodgins. Discusses the imperfections of these records and suggests that the element of time be included, producing as the term of work done the "ton-mile per hour." 2300 w. Ry Mas Mech—Sept., 1897. No. 15037.

Serpollet System.

The Application of the Serpollet Traction System to Main Line Service. (Application du Système de Traction Serpollet à des Wagons Automoteurs de Grandes Lignes.) The Serpollet motor cars have been applied to the Würtemberg railway and also to the Paris, Lyons-Mediteranée system successfully for local traffic. 4000 w. 1 plate. Le Génie Civil—June 22, 1897. No. 15149 D.

Spark Arrester.

Bell's Spark Arrester on the Baltimore and Ohio. Illustrated description of the essential features of the latest type of this device. 600 w. R R Gaz—Sept. 10, 1897. No. 15279.

Unloading.

Tipping Apparatus for Car Unloading. (Appareil Basculeur pour le Déchargement des Wagons.) An illustrated account of the Roisin unloader, with plate showing its arrangement in connection with conveyors at the beet root sugar works of M. Bouchoire. 3000 w. 1 plate. Le Génie Civil—June 5, 1897. No. 15147 D.

Vestibule Train.

New Vestibule Train for the South-Eastern Railway Company, England. Description and dimensions of cars. 1100 w. Engng—Sept. 10, 1897. No. 15465 A.

Weed Burner.

The Atchison Weed Burner. Plan and vertical section of the railroad weed burner in use on the Atchison, Topeka and Santa Fé, with description of operation. 800 w. R R Gaz—Sept. 10, 1897. No. 15277.

MAINTENANCE OF WAY.

Coal Depot.

The New Midland Coal Depot at St. Pancras. Notes on the progress of the work since April, 1896, with a plan of the high and low level of the depot. 700 w. Col Guard—Sept. 10, 1897. No. 15454 A.

Rails.

Effect of Handling on the Life of Rails. H. K. Landis. Discusses the influences which affect the service of a rail, showing that high carbon steel should be carefully handled. 1500 w. Ry Age—Aug. 27, 1897. No. 14970.

Why Rails Break in Track. Editorial discussion of this subject, with a statement of conditions that must be satisfied in order that a rail shall not break in service. 2200 w. Am Eng & R R Jour—Sept., 1897. No. 14985 C.

Rail Fastenings.

Automatic Rail Chairs. (Automatisch wirkender Schienenstuhl.) The Chenu rail chair is arranged with an automatic clamp which utilizes the weight of the train upon the rail to tighten its hold. 1500 w. Zeitschr d Oestrr Ing u Arch Ver—August 20, 1897. No. 15128 B.

Station.

New Railway Station for the Chantilly Race Course. (La Nouvelle Gare des Courses a Chantilly.) A description of a station adapted for prompt handling of large numbers of people; with plate showing arrangement of tracks and system of signals. 3000 w. La Revue Technique—August 10, 1897. No. 15116 D.

Ties.

The Chemical Preservation of Cross-Ties. From the report of the committee at the annual meeting of the Am' Soc. of R. R. Supts. at Nashville, Tenn. Shows the economy due to use of preservatives, and quotes tables from the report of E. E. Russell Tratman. 900 w. Ry Rev—Sept. 25, 1897. No. 15595.

Washouts.

Washouts on the St. Paul and Duluth R. R. and Methods for Repairing. Describes the damage done and how some of the difficulties were met, showing the promptness with which obstructions are removed. Ill. 2500 w. Ry Rev—Sept. 11, 1897. No. 15292.

SIGNALING.

Derailing.

Electric Locks for Derails at Crossings. Diagram showing arrangement of instruments and circuits, with description furnished by Mr. Hansel, general manager of the National Switch and Signal Co. 1300 w. R R Gaz—Sept. 10, 1897. No. 15276.

The Derailed Switch as a Moral and Physical Safety Device. Charles Hansel. Abstract of a paper read at the meeting of the Railway Signaling Club, New York. Also the "Proposed Signals at Passaic River Drawbridge, West Arlington, N. J.," as planned by Mr. Hansel are described. 2500 w. R R Gaz—Sept. 17, 1897. No. 15411.

Signal Lanterns.

Railway Signal Lanterns. (Lanternes de Signaux pour Chemins de Fer.) Experiments on the visibility of signal lights with various arrangements of reflectors. 3000 w. Le Génie Civil—May 8, 1897. No. 15136 D.

Signaling.

Why Automatic Road-Crossing Signaling Apparatus Fails. V. K. Spicer. Considers the various devices for protecting road crossings, and calls attention to the care and watchfulness necessary. 1000 w. Am Eng & R R Jour Sept., 1897. No. 14983 C.

TERMINALS AND YARDS.

New Shops.

The New Shops of the Peoria & Eastern at Urbana. Description of the new shops and yards now being built, with general plan, sections, etc. 2000 w. R R Gaz—Sept. 24, 1897. No. 15529.

TRANSPORTATION.

Accidents.

Train Accidents in the United States in July. Detailed list and classified summary. 3400 w. R R Gaz—Sept. 3, 1897. No. 15029.

Africa.

Cape Railways. A report of the results which, in spite of the difficult conditions, show a surprising degree of prosperity. 1000 w. Engr, Lond—Sept. 17, 1897. No. 15551 A.

Cromer Express.

The Run of the Cromer Express—Great Eastern Railway. A. M. B. Describes the fast run of a train hauled by an oil-fired engine. Ill. 1800 w. Engr, Lond—Sept. 17, 1897. No. 15550 A.

Differentials.

Differential Rates and Excess Fares. Facts given to throw light on the question of regulating competition, with editorial discussion of the general principles involved. 3500 w. Ry Age—Sept. 3, 1897. No. 15213.

Earnings.

August's Heavy Railway Earnings Increases. The most encouraging report of railway operations given for any month for a number of years. 1500 w. Bradstreet's—Sept. 11, 1897. No. 15318.

Prussia's Railroad Earnings. Consular report of the enormous sums earned by the railways under government ownership. 500 w. Cons Repts—Oct., 1897. No. 15389 D.

Freight.

Faster and Heavier Freight Trains and Economical Freight Movement. Editorial on the remarkable record of the Chesapeake and Ohio R. R. in the movement of freight at low cost. 1500 w. Eng News—Sept. 9, 1897. No. 15272.

Locomotive Driving.

The Economical Driving and Firing of the Locomotive Engine. R. M. Deeley. Deals with the various points that effect the economical working of the locomotive engine, as much depends on the methods of firing and working adopted. 4700 w. Eng, Lond—Sept. 10, 1897. No. 15437 A.

Pooling.

Pooling of Freight Equipment. J. R. Cavanagh. Presents causes that show the necessity of considering this problem, and claims for the pooling of freight equipment. Also editorial. 2800 w. R R Car Jour—Sept., 1897. No. 15220.

Rapid Transit.

The Enormous Possibilities of Rapid Electric Travel. Charles Henry Davis and F. Stuart Williamson, Showing in detail the possibility of bringing Philadelphia within thirty-six minutes of New York harbor. Ill. 4900 w. Eng Mag—Oct., 1897. Serial. 1st part. No. 15632 B.

Rates.

Carload versus Pounds as a Rate Basis. Editorial on the demands of the Kansas cattle shippers, giving a brief history of the controversy. 800 w. Ry Age—Aug. 27, 1897. No. 14969.

Differential Rates and Excess Fares. Some further considerations of the problem, with map of standard lines and connections between Chicago and New York. 1700 w. Ry Age—Sept. 10, 1897. No. 15305.

Regulation.

A Decade in Federal Railway Regulation. H. T. Newcomb. Discusses the causes that led to the passage of the Interstate Commerce Law, and the measure of success that has resulted in the ten years since its enactment. 3500 w. Ap Pop Sci M—Oct., 1897. No. 15645 D.

Transportation.

Retrospective and Prospective. W. G. Creamer. Discusses the material advances made in transportation methods, and calls attention to "little things" which would add greatly to the comfort and safety of passengers. 1300 w. R R Car Jour—Sept., 1897. No. 15224.

Transshipment.

Narrow Gauge Light Railways and How to Avoid Transshipment. Everard R. Calthorp. A letter to the editor from the consulting engineer of the Barsi Light Railway. Describes a transportation car, by means of which standard gauge cars of all kinds can be carried over a narrow gauge line. 1400 w. Trans—Sept. 17, 1897. No. 15574 A.

MISCELLANY.

Address.

Address of E E. Russell Tratman, before the Roadmasters' Association. Extracts from the address, touching on wheels, rails, track, &c. 4000 w. Ry Age—Sept. 24, 1897. No. 15573.

British Railroads.

British Railroads for 1896. Editorial on the railway returns recently published, which indicate great prosperity. 1000 w. R R Gaz—Sept. 10, 1897. No. 15278.

Discipline.

Report on Discipline of Committee at Annual Meeting of American Society of Railroad Superintendents. A discussion of the relations of employer and employed, with commendation of what is known as the "Fall Brook" system. 1300 w. Ry Rev—Sept. 25, 1897. No. 15597.

Euphrates.

Railway Scheme in the Euphrates Valley. The practicability of a shorter route to India, and the attempts made to obtain it. 900 w. Cons Repts—Sept., 1897. No. 15057 D.

French Railway.

Northern of France Railway. Information of interest of this most prosperous railway of Europe. 1400 w. Engng—Sept. 10, 1897. No. 15461 A.

Himalayan Railway.

The Darjeeling Himalayan Railway. Details of a unique mountain railway, worked entirely by adhesion. 1700 w. Engng—Sept. 17, 1897. No. 15556 A.

Improvements.

The Lake Front Improvements of the Illinois Central Railroad in Chicago. John Findley Wallace. Gives the history of the litigation between the railroad company and the city of Chicago, with illustrated description of the improvements. 5500 w. Pro Am Soc Civ Engs—Aug., 1897. No. 14995 F.

Journey Notes.

Notes of a Journey from Detroit to Duluth. Comments on the railroads traveled, and cities visited. 2800 w. Eng News—Sept. 2, 1897. No. 15015.

Lumber Preserving.

Tie and Lumber Preserving Plant at Somerville, Texas. Illustrated description of the plant, which comprises all the appliances essential for burnettizing and creosoting, and of the processes used. Other information is also given. 3000 w. Ry Rev—Sept. 11, 1897. No. 15293.

M. C. B. Rules.

The Revised M. C. B. Rules. George S. Hodgins. A discussion of the defects of the code. 2200 w. R R Car Jour—Sept., 1897. No. 15222.

Mounting Wheels.

Mounting Wheels and Gauge of Track. A. P. Gest. Read before the annual meeting of the Am. Soc. of R. R. Supts. at Nashville, Tenn. The correct gauge of car wheels, considered in its relation to the gauge of the track, and particularly with reference to frogs and guard rails. 3300 w. Ry Age—Sept. 24, 1897. No. 15571.

Railway Statistics.

The Railways of the United States in 1896. Statistics of railway construction and operation, taken from advance sheets of Poor's Manual for 1897. 1200 w. Eng News—Sept. 2, 1897. No. 15016.

Report.

Illinois Central Railroad Company. Extracts from the forty-seventh annual report of the directors to the stockholders, with editorial comment. 7000 w. Ry Age—Sept. 10, 1897. No. 15304.

The Atchison, Topeka, & Santa Fé Railway Company. Report for the fiscal year ending June 30, 1897, with editorial comment. 4500 w. Ry Age—Sept. 24, 1897. No. 15572.

Shops.

In the Shops. A statement of results of tests made by the Union Pacific railroad during Aug. to determine the relative value of coal, and a description of jacking up locomotives by compressed air in the Omaha shops of the same company. 900 w. Ry Age—Sept. 3, 1897. No. 15214.

In the Shops. Notes some recent improvements in equipment at the Rock Island shops in Chicago, Ill. 1500 w. Ry Age—Aug. 27, 1897. No. 14971.

Signs.

Standard Roadside and Station Signs—Cincinnati, New Orleans & Texas Pacific Railway. Drawings with particulars concerning the design and construction. 1000 w. R R Gaz—Sept. 10, 1897. No. 15280.

Track Work.

Best Method of Directing and Supervising the Work of Section Foremen. H. W. Church. Read before the Roadmasters' Convention. Discusses the details of the work, and what reports are necessary for the special information of the roadmaster. 2300 w. Ry Rev—Sept. 18, 1897. No. 15504.

Water Analysis.

Water Analysis on the Great Northern Railway. P. H. Conradson. Representative diagrams of results are given and explained, with directions for taking water samples. 1300 w. Ry Mas Mech—Sept., 1897. No. 15038.

STREET AND ELECTRIC RAILWAYS.

Accidents.

The Prevention of Accidents; The Best Method to Accomplish This End. H. S. Cooper. Read before the N. Y. State Convention at Niagara Falls. The answer found is the employment of good men, well cared for, well paid, well disciplined, &c. 3000 w. St Ry Rev—Sept. 15, 1897. No. 15485 C.

Accounts.

A Model Method of Supply Accounts. Gives method devised by Auditor Calderwood, of the Twin City Rapid Transit Company, Minneapolis. 1400 w. St Ry Rev—Sept. 15, 1897. No. 15475 C.

Berlin.

Berlin Elevated Railway. Brief illustrated description of the road, a portion of which will be an underground line. 350 w. St Ry Rev—Sept. 15, 1897. No. 15472 C.

The Electric Tramways of Berlin and Vicinity. Illustrated detailed description. 2000 w. Ry Wld—Sept., 1897. Serial. 1st part. No. 15316 A.

Boston Subway.

Opening of the Boston Subway for the West End Trolley Cars. H. W. Weiler. Brief description of the portion open to public travel. The route is indicated and the work described in detail. Ill. 3500 w. Elec Eng—Sept. 2, 1897. No. 15063.

The Boston Subway. J. E. Talbot. The purpose of the article is to describe in some detail the electrical and cognate features of the work. Ill. 3500 w. Elec Wld—Sept. 11, 1897. No. 15289.

Brooklyn Bridge.

The Accepted Plans for Electric Cars in the Brooklyn Bridge. Shows the course which it is proposed that the cars will take, the arrangement for loading and unloading the passengers, &c. Ill. 900 w. R R Gaz—Sept. 24, 1897. No. 15528.

Cable.

Cable Grip for Decauville Cars. (Grip à Machoires sur Waggonets Decauville.) Showing details of cable grip for small tipping cars used on the Decauville system of narrow gauge industrial railways. 1 plate. 1200 w. Le Génie Civil—July 10. 1897. No. 15162 D.

Charleston, S. C.

Electric Railways in Charleston. Illustrated detailed description of the new system. 2700 w. St Ry Jour—Sept., 1897. No. 15070 D.

The Charleston, S. C., City Railway Company. A description of its power-house and car barn. Ill. 2500 w. Elec Rev—Sept. 1, 1897. No. 15002.

Distribution.

The Three Wire and Other Systems of Distribution for Electric Railway Work. Extracts from the discussion of the paper on "Some Recent Developments in Electric Traction Appliances" read by A. K. Baylor before the (London) Inst. of Elec. Engs. relating to interesting and important features of American and English practice. 5500 w. St Ry Jour—Sept., 1897. No. 15074 D.

Dover.

The Dover Tramways. Illustrated description of recently constructed line now in operation. 1800 w. Elec Eng, Lond—Sept. 10, 1897. No. 15496 A.

Electrical Equipment.

See same title under Electrical Engineering, Power.

Electric Heaters.

The Present Status of Electric Heaters. A report of the principal changes made since last year. Ill. 1800 w. St Ry Jour—Sept., 1897. No. 15073 D.

Electric Railways.

A Decade of Electric Railway Development. William J. Clark. Extracts from a paper read before the Niagara Falls meeting of the New York State Street Railway Assn. Deals with the benefits that the general public have received through the use of electricity as a motive power, and shows that the accidents have been small as compared with steam roads. 1400 w. Elec Wld—Sept. 18, 1897. No. 15445.

Relationship Between Claim and Operating Departments of Electric Railways.—The Prevention of Accidents and Disposition of Claims. Richard W. Day. Read before the Pennsylvania Street Railway Assn. Discussion and suggestions relating to the subjects named. 2000 w. St Ry Rev—Sept. 15, 1897. No. 15479 C.

Employes.

How Can We Increase the Efficiency of Our Employes? W. W. Wheatley. Read before the N. Y. State Street-Railway Convention. Discusses the standard of service desirable for conductors, motormen or gripmen. 3500 w. St Ry Rev—Sept. 15, 1897. No. 15481 C.

English Railways.

Working Expenses of English Electric Railways. Information of the City and South London Electric Railway and the Liverpool Overhead Electric Railway. The other tramways do not issue records from which the expenses can be drawn. Tabulated statements are given. 750 w. Ry Wld—Sept., 1897. No. 15317 A.

Joints.

Casting Street Girder Joints Together. I. R. Newkirk. Read before the Foundrymen's Assn. The work is described and the claims for this kind of joint stated. 1500 w. Ir Age—Sept. 9, 1897. No. 15239.

Kansas City.

Central Avenue Station, Metropolitan Street Railway, Kansas City, Mo. Illustrated description of a good example of modern power-house construction. 2200 w. St Ry Rev—Sept. 15, 1897. No. 15471 C.

Electricity on the Metropolitan Street Railway in Kansas City, An account of the many improvements made, with illustrated description of the new central power house and its system of power distribution for the operation of electric and cable roads. 900 w. Elec Eng—Sept. 9, 1897. No. 15260.

Leeds.

Leeds Electric Tramways. Illustrated detailed description. 2400 w. Elec Rev, Lond—Aug. 27, 1897. Serial. 1st part. No. 15203 A.

Legislation.

Street Railway Legislation in Pennsylvania. Dallas Sanders. Read before the Pennsylvania Street Railway Assn. Reviews the legislation from omnibus days to the present, and records the improvements made. 3000 w. St Ry Rev—Sept. 15, 1897. No. 15480 C.

Measurements.

The Influence of Accurate Measurements upon Economic Operation. Caryl D. Haskins. Read before the N. Y. State Convention. Recommending the use of meters. 1200 w. St Ry Rev—Sept. 15, 1897. No. 15482 C.

Municipal Ownership.

Municipal and Private Ownership and Operation of Street Railways—A Study of Results and Possibilities. Edward E. Higgins. Concludes that the best solution of the problem is found in complete monopoly, private ownership and operation, perpetual franchises and a system of perpetual profit sharing with the municipality, joined to a remission of charges to the public if and whenever profits come to be sufficient for that purpose. 11500 w. St Ry Jour—Sept., 1897. No. 15075 D.

Municipal Ownership and Operation of Street Railways. H. H. Vreeland. Extracts from a paper presented at the N. Y. State Street Railway Assn.'s Convention. Discussion of the difficulties that would arise in purchasing back the franchises, and of various phases of the subject. 2400 w. Elec Wld—Sept. 18, 1897. No. 15444.

New Line.

The Central London Railway. Describes the western part of this road which runs from Marble Arch to Shepherd's Bush. Ill. 4000 w. Trans—Sept. 3, 1897. No. 15307 A.

Paris.

Electric Traction at Paris. From *La Nature*. Illustrated description of the installation and of the system adopted. 700 w. Sci Am Sup—Sept. 11, 1897. No. 15238.

Railway Plant.

The Cicero and Proviso Plant of the West Chicago Street Railroad Co, at Chicago, Ill. Illustrated description. The equipment consists of cross compound direct connected engines and dynamos and water tube boilers. 1000 w. Power—Sept., 1897. No. 15043.

Repair Shops.

Electric Street Railway Repair Shops. Robert Dunning. Read before the N. Y. State Convention. The writers of what have proved most practical for the proper maintenance of the repairs. 1200 w. St Ry Rev—Sept. 15, 1897. No. 15486 C.

San Francisco.

Electric Cars, Car Houses, and Car Repairs in San Francisco. S. L. Foster. A brief account of the cars and system of car maintenance practiced by the Market Street Railway Company, more particularly with reference to the electrical features. Ill. 4200 w. St Ry Jour—Sept., 1897. No. 15072 D.

Power House of the Market Street Railway, San Francisco. Illustrated detailed description of the largest system in the far west. 1400 w. St Ry Rev—Sept. 15, 1897. No. 15476 C.

Service.

Street Railroad Service Required by the Municipality. Deals principally with the service which city regulations prescribe, such as the regulation of the headway, the hours during which cars must run and the rate of speed. 2500 w. St Ry Rev—Sept. 15, 1897. No. 15474 C.

Shafts.

Shafts. E. Debus. The importance of this subject to the street railway engineer, with extracts from paper by G. W. Manuel, and from the discussion of the same. 2000 w. St Ry Rev—Sep. 15, 1897. No. 15477 C.

Steep Grades.

An Electric-Cable Railway. M. H. Bronsdon. Describes and illustrates a system suitable for cases where it is thought desirable or necessary to have a safety device, and one which is applicable to any grade regardless of the inclination. 800 w. St Ry Rev—Sept. 15, 1897. No. 15478 C.

Street Railroads.

Advantages of Up-to-date Street Railroad Service. Why the Rate of Fare Should not be Reduced. C. S. Rossiter. Read before the N. Y. State Convention at Niagara Falls. Discusses the need of electric street railways in cities, and the distance possible to travel for a single fare. 1300 w. St Ry Rev—Sept. 15, 1897. No. 15484 C.

Facts and Fancies Concerning Street Railroads. W. W. Cole. Read before the N. Y. State Convention at Niagara Falls. Discusses public and private ownership, and the attitude of leading magazines to this question. 2000 w. St Ry Rev—Sept. 15, 1897. No. 15483 C.

Suburban Railroad.

The Suburban Railroad of Chicago. Illustrated detailed description. Part of this system consists of sections of steam roads equipped for operation by electricity, and also used for street cars. 1400 w. St Ry Jour—Sept., 1897. No. 15071 D.

Third Rail.

The Crocker Safety Sectional Third Rail System. Describes the system and the test made in the yards of the American Ordnance Company at Bridgeport, Conn. Ill. 1000 w. Elec Eng—Sept. 23, 1897. No. 15518.

Track.

Cost of Track Construction. Specifications of eleven methods of construction with the esti-

mates of cost, as prepared by John A. Beeler for the Denver Consolidated Tramway Co. 350 w. St Ry Jour—Sept. 15, 1897. No. 15473 C.

Traction.

Electric Traction on Elevated Roads. Leland L. Summers. Discusses principally the Sprague system. 1800 w. Elec Eng—Sept. 15, 1897. No. 15491.

See same title under Mechanical Engineering. Compressed Air.

Tramway.

A New System of Electric Traction for Tramways. (Nouveau Système de Traction Electrique pour Tramways.) An illustrated account of the Bersier System at Havre, with covered conduit and movable lid. 3000 w. Le Génie Civil—June 19, 1897. No. 15153 D.

Brussels Electric Tramways. Ernest Kilburn Scott. Information of special features in the construction and equipment, of routes, extensions, and matters of interest. Ill. 2200 w. Elec Rev, Lond—Sept. 17, 1897. No. 15579 A.

Electric Traction as Applied to Tramways. Frank Gaskell. The first of a series of articles describing and estimating the cost of the best systems of electric traction. 1500 w. Elec, Lond—Sept. 3, 1897. Serial. 1st part. No. 15306 A.

Electric Tramways. F. J. Warden Stevens. A review of the various forms of traction in use at the present time. Part first briefly considers horse, steam, gas or oil, and the cable systems, and commences the discussion of electric systems. 2200 w. Arch, Lond—Sept. 17, 1897. Serial. 1st part. No. 15566 A.

The Polyphase Electric Tramway at Lugano. (Tramway Electrique à Courants Polyphasés de Lugano.) An illustrated account of this recently constructed road. The alternating polyphase current is generated by water power over 7 miles from the town. 5000 w. Le Génie Civil—July 10, 1897. No. 15161 D.

Traveling Platform.

Proposed Traveling Sidewalk. (Projet de Plate-Forme Mobile.) An illustrated description of the elevated traveling sidewalk for the Paris Exposition of 1900, with plan and plate of details. 1 plate. 2500 w. Le Génie Civil—July 3, 1897. No. 15159 D.

Underground Trolley.

Construction Details of the Underground Trolley in New York City. Interesting description of the construction, with illustrations. 1300 w. Elec Wld—Sept. 18, 1897. No. 15443.

Electric Tramways with Underground Conductors. (Ueber Elektrische Bahnen mit Unterleitung.) Describing various existing systems of underground trolleys used in Germany, with sections of conduits and arrangement of switches, turnouts, etc. 6000 w. Zeitschr d Oesterr Ing u Arch Ver—August 13, 1897. No. 15126 B.

The Underground Trolley in New York City. Brief illustrated description of the fine construction now being put in place. 700 w. Elec Wld—Aug. 28, 1897. No. 14964.

Wheels.

Street Car Wheels; Shall They Be Made Heavier? F. D. Russell. Read before the N. Y. State Convention. The changes needed because of change of power. Thinks, taking the 32-in. wheel for a standard, that 380 lbs. to 400 lbs. on 2¼-in. and 2½-in. tread is not too much for the present service. 1800 w. St Ry Rev—Sept. 15, 1897. No. 15487 C.

Zurich.

The Electric Tramways of Zurich. (Tramways Electriques de Zurich.) Describing this important and interesting plant, in which gas engines operated by producer gas furnish the motive power for the electric generators. 4000 w. Le Génie Civil—May 15, 1897. No. 15138 D.

BOOKS OF THE MONTH

THE STANDARD ELECTRICAL DICTIONARY. A Popular Dictionary of Words, Terms, and Phrases Used in the Practice of Electrical Engineering. Second edition, revised and enlarged. By T. O'Conor Sloane. New York: Norman W. Henley & Co., 1897. Cloth, $3.00.

Dr. Sloane's electrical dictionary has been before the public for several years, and during that time it has found most acceptable use in many quarters. This, we believe, has been due, not only to the demand for an electrical dictionary in itself, but also to the fact that the work contains more than mere definitions, and really partakes of the nature of a compact electrical encyclopedia. Besides concise definitions of terms, processes, and apparatus, it often gives brief descriptions, with such illustrations as are necessary to complete the account. Synonyms of terms are also given, and a very full index dispenses with the need of cross-references.

The present edition contains an appendix of fifty pages, bringing the book well up to date,—a very necessary duty in view of the advances in electrical science since the work was originally issued,—and in the appendix will be found terms relating to radiography, wireless telegraphy, and other recent lines of investigation, together with the definitions of electrical units as determined at the international congress of 1893.

PRACTICAL ICE MAKING AND REFRIGERATING. A Plain Common Sense Series of Papers on the Construction and Operation of Ice-making and Refrigerating Plants and Machinery. By Eugene T. Skinkle. Chicago: H. S. Rich & Co., 1897. Cloth, $1.50.

Eminently a practical book by a practical man, written in an entertaining, chatty way about a subject of continually-increasing importance. That it is somewhat rambling and discursive in style is probably due in part to the fact that the matter was originally published as a number of separate articles in the pages of *Ice and Refrigeration*, and perhaps in part also to the writer's desire to avoid formality; but there is much sound common sense in the book, and the author's evident earnestness is doubtless born of hard practical experience. The scientific engineer will have to look elsewhere for the mathematical computations involved in the problem of producing cold, but he may learn from this little book how far apart to space his pipes, and how to connect them to the best advantage; he will learn better than to use pipe which is galvanized inside, and will find some strong arguments against "oil injection" as a means of doing away with clearance. All may not agree with Mr. Skinkle's arguments and deductions, but he has made a very interesting series of practical talks about a subject which he has evidently studied in the master-school of experience.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE, Vol. LI. Edited by Bennett H. Brough, secretary. E. & F. N. Spon, London, 1897.

The fifty-first volume of the *Journal of the Iron and Steel Institute* contains the usual collection of valuable papers from members in various parts of the world, together with the discussions and correspondence elicited. Mr. Head's paper on charging open-hearth furnaces by machinery is especially devoted to the Wellman electric open-hearth charging machine as used in the United States. Mr. Bertrand's paper on the Bertrand-Thiel open-hearth process is limited to an account of the practical working of the new combined process in the steel works at Kladno, in Bohemia. Two papers by Mr. Royston deal with "Malleable Cast Iron" and with "The Relation of Carbon to Iron at High Temperatures." Baron Jüptner von Jonstorff contributes two papers on "The Influence of Phosphorus on Cold-Shortness" and "The Determination of Hardening Carbon and Carbid Carbon." The American membership is represented by Dr. Henry M. Howe in a reply to the discussion of his previous paper on "The Hardening of Steel," and by Mr. Thos. D.

West on the "Utility and Economy of Central Blast Cupolas." A very comprehensive and thoroughly classified collection of notes on the iron and steel industries follows, together with the statistics for the previous year and a bibliography of the principal works relating to iron and steel published during the first half of 1897.

LE FOUR ELECTRIQUE. By Henri Moissan. Paris: G. Steinheil, 1897.

M. Moissan's work with the electric furnace is well known to those who have followed the development of this important branch of electro-chemistry, he having been practically the first to use it systematically as a means of chemical investigation; and the record of his discoveries and researches has appeared in intermittent form in the shape of communications to the *Comptes Rendus* of the French Academy.

The present volume is practically a compendium of these previous papers, arranged and classified so as to form a very complete account of the methods of using the electric furnace in general, and of the results of M. Moissan's researches in particular.

After giving a description of the author's form of furnace and its operation, the behavior of the various refractory oxids is detailed, including their fusion, crystallization, and volatilization, with some especially interesting facts concerning the behavior of lime at the extraordinarily high temperatures attainable. This is followed by a chapter upon carbon, most of our recent knowledge of which element we owe to the electric furnace and to Moissan. A whole department of chemistry is devoted to the study of the carbon compounds, while but little, until very recently, has been known about carbon itself, considered as an element. The present work discusses it, in its three forms, —graphitic, amorphous, and crystalline,— and gives much space to the production of the latter in the form of artificial diamonds.

The electric furnace has also made possible the isolation in considerable quantities of numerous refractory metals, such as uranium, tungsten, and chromium, hitherto prepared only at great cost and in very small quantities. The production of the metallic carbids is another important function of the electric furnace, evidently destined to attain much commercial importance, and altogether the scope of this new metallurgical weapon it is at the present impossible to limit or foresee.

The book is at the same time valuable as a record of past researches and a guide to future work, and entitles its author to high rank as an investigator in modern science.

BOOKS RECEIVED.

Missouri Botanical Garden. Eighth Annual Report. Published by the board of trustees. St. Louis, Mo., 1897. Cloth.

Iron and Steel and Allied Industries in all Countries. James M. Swank, Washington. Government Printing Office, 1897. Paper.

The Money Question: A Handbook for the Times. Henry V. Poor. New York: H. V. & H. W. Poor, 1897. Paper, 50 cents.

Poor's Manual of Railroads. Thirtieth Annual Number. New York: H. V. & H. W. Poor, 1897. Cloth, $7.50.

New York State Reformatory. Twenty first Year Book. Elmira, 1897.

Journal of the Iron and Steel Institute, Vol. LI. Edited by Bennet H. Brough, secretary. London: E. & F. N. Spon; New York: Spon & Chamberlain, 1897. Cloth.

Some Fundamental Propositions Relating to the Design of Frameworks. Frank B. Cilley. Reprint from Technology Quarterly Vol. X. No. 2, June, 1897. Paper.

The Standard Electrical Dictionary. T. O'Conor Sloane. Second edition, revised and enlarged. New York: Norman W. Henley & Co., 1897. $3.00.

Current Transportation Topics, II. Recent Supreme Court Decisions and their Significance. Emory R. Johnson. Philadelphia, American Academy of Political and Social Science, 1897. Paper, 15 cents.

A Field Manual for Railroad Engineers. J. C. Nagle. New York: John Wiley & Sons; London: Chapman & Hall, Ltd., 1897. Morocco flap, $3.00.

Practical Ice Making and Refrigerating. Eugene T. Skinkle. Chicago: H. S. Rich & Co., 1897. Cloth, $1.50.

The Express Messenger and Other Tales of the Rail. Cy Warman. New York: Charles Scribner's Sons, 1897. Cloth, $1.25.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Edward P. Allis Co., Milwaukee, Wis., U. S. A.=Mining Catalogue "No. 36"; a handsome illustrated book of about 250 pages. Section 1 is devoted to engines, hoists, pumps, boilers, belting, and fixtures, 56 pages; section 2, to crushing, sizing, and concentrating machinery, 65 pages; section 3, to stamp, chlorination, and cyanid mills, 49 pages; section 4, to furnaces and machinery and appliances for smelting and refining works, 37 pages; section 5, to drills, air-compressors and receivers, 48 pages. There is an index to each section. The catalogue has the form of a series of excellent illustrations, with brief descriptive text accompanying each, and much collateral information as to cost of operations, specifications for typical plants, arrangement of machinery, and auxiliary appliances.

Gorton & Lidgerwood Co., New York City.= Small circular entitled "A Warm Discussion," giving general description, detailed dimensions, heating capacities, and prices of different styles of their side-feed boilers, burning hard or soft coal, for steam and hot-water heating.

Pancoast Ventilator Co., Philadelphia, Pa., U. S. A.=Price-list of ventilators manufactured by them, giving the capacity in square inches of each size, and results of comparative tests made by the Master Car-Builders' Association in the United States.

Gold Street-Car Heating Co., Chicago, Ill., and New York City.=Illustrated catalogue of electric heating apparatus, especially for street-cars, but adapted also to heating dwellings, steamers, etc.; describes also the "sealed jet system of hot-water circulation" for car-heating.

Cahall Sales Department, Pittsburg, Pa., U. S. A.=Leaflet giving in full the results of a test made by Geo. H. Barrus, of Boston, Mass., of a 200-h. p. Cahall water-tube boiler, showing remarkably high evaporative results and an excess of power over the guarantee.

Mason Electric Equipment Co., Chicago, Ill., U. S. A.=Leaflet stating claims and merits of their non-soldering line-hanger for electric railways.

Falls Rivet & Machine Co., Cuyahoga Falls, Ohio, U. S. A.=Illustrated leaflet of the Acme mechanical stoker, stating its advantages as to economy, efficiency, and convenience.

Porter Standard Motor Co., Lebanon, N. H., U. S. A.=Illustrated catalogue "No. 5," giving sizes, description, and prices of motors, batteries, and fans. Also leaflets of the "Ajax" battery motor and compound Fuller battery.

Northern Electrical Manufacturing Co., Madison, Wis., U. S. A.=Illustrated catalogue "No. 7," containing a chapter on electric-driving and descriptions, with half-tone engravings of "Northern" dynamos and motors as applied to machine-shops, press-rooms, launches, manufacturing establishments, and other classes of work.

The E. Horton & Son Co., Windsor Locks, Conn., U. S. A.=Illustrated descriptive catalogue, with price-lists, of the Horton lathe chucks and drill chucks as adapted to all kinds of machine work; also of repair parts and auxiliary tools. The pamphlet has 74 pages, and is indexed.

Jeanesville Iron Works Co., Jeanesville, Luzerne Co., Pa., U. S. A.=Handsome illustrated catalogue of 80 pages, in stiff covers, devoted to mine- and special-pumping machinery in great variety of patterns, styles, and adaptation to peculiar conditions of duty or power. The catalogue has convenient diagrams for ordering repair or duplicate parts, and an appendix of tables of water-pressures, friction-losses, and other useful information.

Government Printing Office, Washington, D. C., U. S. A.=Catalogues of United States public documents for July and August, 1897.

Michigan College of Mines, Houghton, Mich., U. S. A.=Prospectus for 1897-98, with plates and tables, giving the officers, course of instruction, degrees, and all other information regarding the college.

Union University, Schenectady, N. Y., U. S. A.=Special circular of important improvements recently inaugurated in the engineering school, involving changes in qualifications for admission, reorganization of curricula in general and sanitary engineering, and the final establishment of a course in electrical engineering.

Rochester Atheneum and Mechanics' Institute, Rochester, N. Y., U. S. A.=Circular of Information for 1897-98.

H. K. Porter & Co., Pittsburg, Pa., U. S. A. ="Light Locomotives," eighth edition; an unusually fine, well-bound catalogue of over 200 pages, with clear small-scale illustrations (line engravings and half tones) and concisely-worded descriptive text and general specifications. The range of types is very large, comprising locomotives for all sorts of service, from 84,000-lb. passenger and freight engines to the smallest industrial or mine locomotive, and for steam, compressed-air, and electric power. The descriptive specifications are accompanied by a full code for ordering by telegraph. About 80 pages are given to tables and data which practically constitute a simple but excellent handbook of light-railway building and operation. They includes tables and memoranda of tractive force, of hauling capacity, of grades, curves, gage of track, elevation of rail, speed and loads, chapters on rails and special-service railroads, special system of haulage, estimates of cost, and comparisons of weights and measures. The catalogue is well indexed.

Boston Belting Company, Boston, New York, and Buffalo, U. S. A.=Card, describing advantages of Phoenix flange and joint packing,

R. D. Wood & Co., Philadelphia, Pa.=Elegantly printed and illustrated catalogue of hydraulic tools, cranes and machinery.